SCIENCE

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FRIDAY, NOVEMBER 18, 1898.

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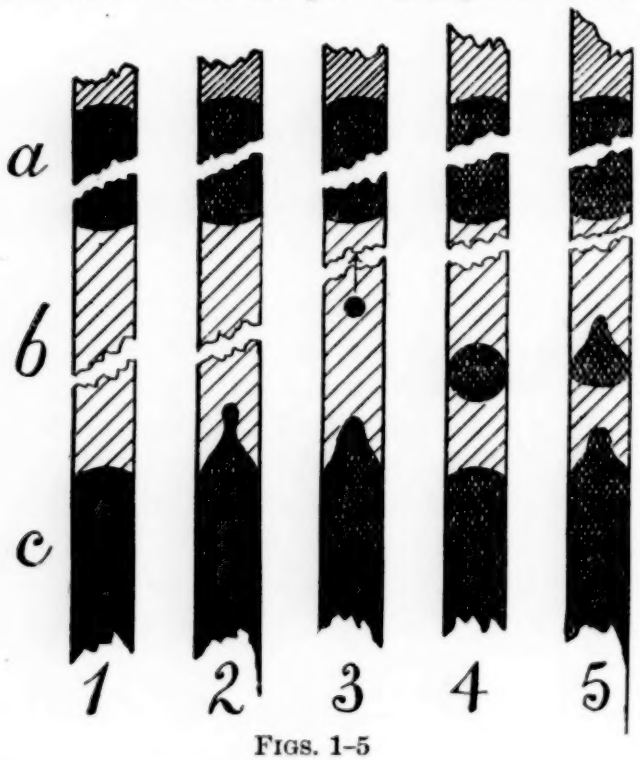
MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

INERTIA AS A POSSIBLE MANIFESTATION OF THE ETHER.

IN the *American Journal of Science* for October I described certain experiments on the compression of coagulated jelly, to which I am inclined to attach some importance, since they establish a case of well defined persistent motion of material bodies in a highly viscous (solid) medium, as the sheer result of the breakdown of stress in the medium in question, and quite without the agency of any force 'acting at a distance.' I ask the reader's indulgence if I recall the main features of these experiments here, for the remarks which I propose to make in the present communication are to be based directly upon them and would lose their point in a mere reference.

Given a thread of firmly coagulated (10%–20%) gelatine solution *b*, Fig. 1, 10–20 cm. long, between terminal threads of mercury *a* and *c* in a fine bore ($\frac{1}{3}$ mm.) strong capillary tube (not shown in figure). The upper thread is fixed; the lower is movable and transmits the pressure of a strong force pump. As pressure increases, it will be found that the originally convex meniscus in Fig. 1 is gradually more and more sharpened conoidally upward, until the unstable figure 2 is reached, after which, as in 3, a small projectile, usually round and often less than $\frac{1}{10}$ mm. in diameter, is shot upward 10–20 cm., against gravity and against

the relatively enormous viscous resistance of the coagulated colloid. The motion of the projectile is extremely rapid at first (say several *met./ sec.*, or more), but gradually slows down, until after 5–10 minutes it has been reduced to the merest creeping visible in the telescope. This phenomenon



Figs. 1–5

is repeated on increasing the pressure, but even at the same pressure many projectiles may be successively shot off to be distributed along the axis of the column. Later projectiles frequently actuate the earlier ones to renewed motion (5–10 cm.) without touching them and even after the latter have come to rest.

An interesting case is the *drop* of mercury purposely broken off ahead of the meniscus, as shown in Fig. 4, while the colloid was yet liquid. After thorough coagulation the effect of pressure is shown in Fig. 5. The drop soon takes a conoidal form,* and thereafter shoots off projectiles of mercury from its apex, being continually replenished by bombardment from the meniscus below, changing form but remaining in place. On another occasion, however, the drop deliberately exploded, being thereafter represented by some dozen small projectiles distributed through the lower 10 cm. of the colloidal column. The top meniscus neither moves nor changes form.

On gradually removing pressure the experiment is reversed, *i. e.*, the projectiles move in a somewhat similar manner back toward the (lower) meniscus out of which they originated. But the march back is not complete, showing that much energy is wasted in virtue of viscosity.

Experiment explained.—My explanation of these occurrences is as follows: The phenomenon throughout is elastic in character. The lower end of the colloidal column, loaded with a uniformly distributed pressure, yields like an elastic disc—least at the edges where it is sustained by the walls of the capillary tube and most near the center; for the jelly is not quite incompressible (compressibility of the order of about 10^{-6} per atmosphere). The column is telescopically sheared, so to speak, and gives way symmetrically with respect of the axis. When stress exceeds the limits of rupture the strain breaks down, as indicated by the motion of the mercury projectile.

Consider the intrusion of the mercury globule for a moment; ahead of it there is always the continuous overstrained solid colloid; behind it discontinuous or triturated colloid, the débris of the original continuous column. The former transmits stress like a solid, locally showing definite rigidity; the latter transmits hydrostatic stress. So the projectile is pushed forward by rear-end pressure communicated by the mercury, but pushed forward at a gradually retarded rate; for, though the intensely viscous quasi-liquid not exactly

"...drags with each remove a lengthening chain,"

it must certainly make its way through an ever-lengthening channel, which eventually,

*The curvature due to stress is, of course, superimposed on the curvature of the globule.

in fact, seals itself quite up again. The marvel is that the projectile gets so far after the first breakdown. It could not do so if the main part of its motion were not swift, indicating a very steep pressure gradient. At all events, the time soon arrives (5–10 minutes) when the elastic resistance of the strained colloid ahead of the projectile is in excess of the remnant of hydrostatic pressure behind it, and the projectile stops. It would gradually stop even without the recementation of the triturated channel, but the fact that the antics begin all over again with the next projectile is proof (were it needed) that the column has actually resumed continuity. It again gives evidence of definite rigidity.

Other things I would like to add, but I have already trespassed too far.

The ether.—Now, whenever one finds out anything about jelly—something of an order just a little above the kitchen I mean—one has the right to traipse in the footprints of well-known great thinkers and approach the ether. I am not given to denying myself, so I shall have my ether, which, just like the jelly, is to be solid or liquid under like conditions, as I please. Nobody ever caught such an ether before (though it has been fished for), which, to repeat, shall be either continuous and rigid or discontinuous, triturated, virtually rigid, as the conditions warrant. Note that since it *must* be elastic* it may as well be *solid*, without invoking essentially new conditions.

Beyond this my ether is to have no respectable properties at all, except that if broken it seals itself up again, as all ethers do, particularly under pressure, and that it resists breakdown as this becomes more rapid. It is to be nearly incompressible, brittle, and in the first instance (by no means the last) free from inertia. Such an ether can transmit stress instantaneously like a stick, or, better, like that imponderable instrument with which people poke fun at us. The ether cannot of itself vibrate. Though incompressible, it may become virtually so by enclosing triturated regions, particularly in the pressure of matter.

The body.—With these admissions, I will examine, for a moment, the relations of this ether to a physical body, regarded as a grouping of ultimate particles fixed relatively to each other. I shall use this body chiefly to produce the triturated regions, with a view to dropping* it from the considerations *altogether*, if it can be made to appear non-essential.

Let there be given a region free from force. Let a body be imbedded in the solid (continuous) ether, permeating the region and permeating the body intramolecularly as well. In the first instance, inertia as a physical property is to be attributed neither to the body nor to the region.

Let the body be moved by an impulse from without. Immediately there will be discontinuous ether capable of transmitting hydrostatic pressure *behind* the body, or, better, behind each ultimate particle of the body, while the sheared continuous ether pervades in front of it, in the direction of motion.

Now, suppose that the trituration in question is a marked occurrence, accompanied, therefore, by increase of volume. There must then be a simultaneous manifestation of hydrostatic pressure in the triturated region greater, as the surrounding solid ether is more rigid.

Regions of triturated ether.—Now, consider the triturated region (however produced) by itself, supposing no material ultimate particles present therein.†

* It is unfortunate that all ethers must be elastic. This really introduces the whole of our molecular machinery over again and indicates nothing ultimate.

*The remarks in the *American Journal* refer to this body in place, in the manner set forth by the above text.

†I have also carried out these ideas, keeping the

As the case stands (no inertia), the region is the fund of the whole energy imparted by the impulse. In other words, $\int pdv$ can not vary for the triturated region if no new impulse is at hand. But the ether, like the jelly, is supposed to be *self-sealing* under pressure; *i. e.*, the tendency to make $\int pdv$ vanish. Hence, in homogeneous ether the triturated region, if alone, can not be at rest;* it may either break down fresh continuous ether on one side as fast as it seals itself up again on the diametrically opposite side, always retaining $\int pdv$ constant; or it may seal internally while it increases in area externally, forming an ever-widening closed shell whose energy per cm^2 eventually obeys the orthodox law; if a body were present the region might become distributed among its vibrating molecules, etc.

First law of motion.—Now, as the breakdown progresses from layer to layer *successively*, the region will seal up soonest where it broke down first; for the pressure is constant throughout the region. Hence the motion of the region must be *uniform* and *linear* in the direction of the impulse. This seems to me to be an approach to Newton's first law. Rest, though impossible for a single region, may occur in a cluster of regions (see below), the individuals of which move.

Since energy imparted to the region in any other direction must act in the same way, I conclude that the new velocity may be compounded vectorially with the initial velocity.

Second law of motion.—The next question at issue is this: Can the region be made to behave like a massive body, even though made of stuff destitute of inertia. For ulterior reasons it is undesirable to change the volume of the region appreciably; any energy can, nevertheless, be stored within, by increasing the fineness of trituration. The effect of this is to increase the internal pressure and to increase proportionally, at the same time, the rate of recementation behind (in the direction of motion) and the rate of breakdown in front. Hence the region may be treated as moving faster in proportion as the energy imparted by the impulse is greater. Sealing is supposed to occur more rapidly under pressure, and the two rates must keep pace with each other if there is to be conservation of energy.

The resistance to increased breakdown would thus vary in the first place with the change per second of the velocity; for a regular succession of impulses, *i. e.*, a constant force, must produce a correspondingly regular succession of increments of velocity, or constant acceleration; it would vary in the second place with the total *front* of ether broken down. The latter quantity is thus left to account for mass. For simplicity let the regions occur clustered like the molecules of a body, and be all of the same spherical volume. Then the resistance to breakdown will vary, *caet. par.*, with their number per unit of volume, or, in other words, with the *density of distribution* of the regions within the body. This seems to be an approach to Newton's second law regarded as a manifestation of the ether.

A body built up of such similarly circumstanced regions would virtually be a massive body.* Each component region, if not

body in place, with each of its ultimate particles associated with triturated ether, analogously to the mercury projectiles in the above experiment. But since my remarks can be made without reference to material molecules, I have preferred to drop the body (unwisely perhaps) as an unnecessary complication.

* The rate of motion varies with the fineness of trituration, as will be indicated below; *i. e.*, it varies with the pressure in the region.

* The third law of motion, inasmuch as it deals with the occurrence of stress between two or more regions, must ultimately culminate in an explanation of gravitation. One naturally shrinks from touching this, though I hope to consider the reflection and collision of the regions at some other time.

interfered wit,h would maintain a constant rate of br akdown, implying constant velocity, as already explained.

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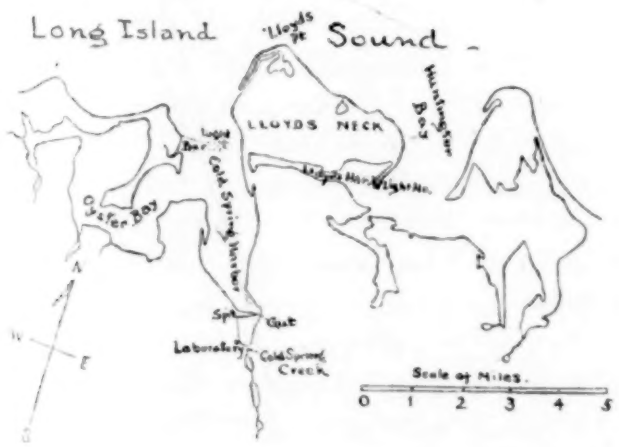
THE FAUNA AND FLORA ABOUT COLDSPRING HARBOR, L. I.

THE Biological Laboratory of the Brooklyn Institute of Arts and Sciences, located at Coldspring Harbor, Long Island, has during the nine years of its existence accumulated an important lot of information concerning the animals and plants of the vicinity. Especially during the present season has the attention of the investigators been in great part directed towards a biological survey of the locality. Of the survey the following may be regarded as a preliminary report.



The conditions at Coldspring Harbor are as follows: The Harbor is a body of water about five miles long and from one and a quarter miles to a quarter of a mile wide, which opens at its broader end into Long Island Sound, itself an inland sea, about eighty miles from where it debouches into the open ocean. Opening into Coldspring Harbor at about the middle of its western side is Oyster Bay, a tortuous body of water running back some six or seven miles and having a breadth varying from one and a-half miles to half a mile. Both Coldspring Harbor and Oyster Bay receive at their upper ends fresh-water streams of considerable volume, and at intervals along their coast line, smaller ones. Consequently the density of the water is low, being about 1.019 at flood-tide near the surface in the middle of the outer harbor. Coldspring Harbor is a sunken river valley with abrupt fiord-like sides, which extend back into the country for three miles from the upper end of the Harbor. In the valley runs the stream of Coldspring Creek, which expands at three different levels into broad, deep ponds, connected by waterfalls and shaded by dense foliage. The woods which rise from these ponds are densely grown with a rank vegetation and are rich in the fleshy fungi which accompany a moist climate.

Coldspring Creek, flowing, laden with silt, into the upper end of the Harbor, has formed there, with the aid of the sea, a sand spit which nearly cuts off an inner basin, about 3,000 feet long by 2,000 feet wide, from the outer harbor. The water of the inner basin is decidedly brackish, at high tide varying from 1.006 to 1.016 at the surface and from 1.006 to 1.018 at the bottom. The passage from the inner basin to the Harbor is only 200 to 300 feet wide at low tide, and through this 'gut' the water flows at times with great rapidity. The mean range of tide is 7.3 feet. The inner basin, which is gradually silting up, exposes about half of its bottom at every low tide for an hour or so. In the outer harbor, above the entrance of Oyster Bay, the water is uniformly 15 to 18 feet deep at low tide. Immediately below Oyster Bay entrance is a bar with only 6 to 10 feet of water at low tide. At the eastern end of this bar is a channel 72 feet deep. Outside the bar the water deepens steadily towards the middle of the sound.

The steep sides of the harbor are piles of glacial drift, full of clay, siliceous sand, gravel and boulders of varying size. This

determines the prevailing character of the shore line, sandy or gravelly beaches with boulders extending into deep water and most abundant at the base of the worn-off bluffs.

Mud flats are common, but for the most part underlaid by sand at a depth of one to three feet. A mud flat extends from parts of the sand spit at the level of mean low tide. No rock occurs in place, but on many headlands the accumulated boulders at the base of the bluffs form an extensive rock-work. At intervals the shore line of the harbor is diversified by salt meadows, partly enclosed salt ponds and shallow 'harbors' and bays.

THE FAUNA ABOUT COLDSPRING HARBOR.

The situation of the laboratory is unique in its combination of immediately accessible faunas of the sea, fresh-water and woodland, all very rich in individuals and species. Some of the commoner or more interesting forms may here be enumerated. The list may be prefaced with the statement that, owing to the fact that the Harbor is so nearly an inland sea, there are few stragglers in the marine fauna; what one finds belongs to the place—its presence is determined by the local environment.

Protozoa: Volvox and Stentor are extremely abundant in the lakes.

Spongiæ: *Spongilla* (?) in the stream connecting the lakes. The boring sponge, *Clione sulphurea* Desor, is abundant. There are various other species in the Harbor, unidentified.

Anthozoa: The coral *Astrangia Danæ* is one of the common products of dredging at the lower end of the Harbor. Three species of sea anemones are common. Among them *Sargartia leucolena* and *Halocampa producta* are common in the sand.

Hydrozoa: Hydra is common in the lakes. Of the hydroid stocks may be mentioned *Obelia*, *Campanularia*, *Podocoryne*, *Hydractinia*, *Plumularia* and *Bougainvillia*, which are abundant, and *Perigonimus*, *Eudendrium* and *Tubularia*, which are less common. Jelly-fishes of several other species occur in the tow.

Ctenophoræ: *Mnemiopsis Leidyi* has been abundant throughout the present summer.

Echinoderma: *Asterias forbesii* is very abundant, especially on the outer bar. Its numerous abnormalities have attracted some attention this season. The sea-urchin, *Arbacea punctulata* Gray, is found occasionally in dredging, but is not abundant. The Holothurian *Synapta Girardii* is abundant in the sand spit near the laboratory and is sometimes found in the tow. *Synapta roseola* Verrill also occurs. The tow frequently contains star-fish larvæ.

Balanoglossus: A form of this genus, apparently different from *B. Kowalevskii*, occurs in the sand spit.

Mollusca: The shores of Long Island have long been famous for the richness of their molluscan fauna. About 100 species from the Harbor have been identified* during the present season. Among the more abundant genera are *Chiton*, *Fulgur*, *Sycotypus*, *Tritia*, *Ilyanassa*, *Urosalpinx*, *Eupleura*, *Neverita*, *Littorina*, *Teredo*, *Xylotrya*, *Mya*, *Solen*, *Mactra*, *Venus*, *Liocardium*, *Nucula*, *Scapharca*, *Mytilus*, *Modiola*, *Pecten*, *Anomia*, and the semi-domesticated oyster. Slugs of various species are common in the woods. Few of the various nudibranchs have been identified. Squids' eggs are occasionally dredged and adult squids occur, although they are irregular in their appearance.

Bryozoa: Among the common marine forms may be mentioned *Crisea eburnea*, *Bowerbankia*, *Alcyonidium hispidium* and *Bugula turrita*. In the lakes *Pectinatella magnifica* Leidy is abundant. *Pedicillina* has been found.

Tunicata: *Botryllus* is common. *Molgula*,

* Chiefly by Mr. Francis N. Balch.

probably of two species, is obtained abundantly. *Perophora viridis* is found on algæ from near the Sound. Common also is *Amaræcium constellatum*, found at the Harbor's mouth.

Platyhelminthes: Fresh-water *Turbellaria* are abundant. *Bdelloura propinqua* is common on *Limulus*. *Apoblema* (*Distomum*) *appendiculatum*, which occurs abundantly in Copepods here, has been made the subject of a memoir by Professor Henry S. Pratt, of Haverford College. The large Nemerteans, *Cerebratulus Leidyi* and *C. lacteus*, occur in the sand spit. Of Annelids over fifteen species have been identified, chiefly by Dr. J. I. Hamaker. *Nereis virens*, although near the southern limit of its area of distribution, is extremely abundant. The more southern *Nereis limbata* is abundant. Other common species are: *Arabella* (*Lumbriconereis*) *opalina*, *Euglycera* (*Rhincobolus*) *dibranchiata*, *Clymenella torquata*, *Amphitrite ornata*, *Chætobranchus sanguineus*, *Cirratulus grandis* and *Serpula dianthus*.

Rotifera: These organisms are extremely abundant in the lakes, but no species have been identified.

Sipunculoidea: *Phascolosoma* occurs on a sand spit near the lighthouse at the entrance to Lloyd's Harbor.

Entomostraca of many kinds are abundant in the lakes. A few minutes' towing will collect a countless number of individuals of *Daphnia*. Of the marine copepods *Acartia* is one of the most abundant. Many Balanidæ occur and their larvæ are common on the tow.

Amphipoda: *Caprella acutrifrons*, new variety, can be obtained by the pint in the 'gut.' *Talorchestia longicornis* is abundant on the sand spit.

Isopoda: *Bopyrus* is very common on prawns, *Idothea irrorata* on eel grass, and the *Oniscidæ* about the springs.

Podopthalmata: *Squilla empusa* is common at the sand spit and *Mysis* in the tow. Among the decapods there have been identified *Homarus vulgaris*, *Callianassa* and *Gebia*, which occur in the sand spit. Numerous hermit crabs occur. Other crabs are unusually abundant. The dredge or tangle brings up from the region of the outer bar *Libinia caniculata*, very large and numerous; *Libinia dubia*; *Callinectes hastatus*, not common; *Platyonichus ocellatus*, or 'lady crab;' *Panopeus Sayi*; *P. depressus*; *Cancer irroratus*. On the shores fiddler crabs of two or three species abound.

Pycnogonidia: *Pallene empusa* Wilson is common.

Limulus is abundant on the sand spit, near the laboratory.

Insects: The moist woodland about the lakes and springs offers a remarkably rich collecting ground for insects. One of the most striking species, on account of its size and abundance, is a form of the cricket-grasshopper, *Ceuthophilus*

Vertebrates: Some twenty species of fish have been identified.* Dogfish and sand sharks seem to be common. The stomachs of nine of the former have been examined during July of this year, and an aggregate of eleven squillas, four spider crabs, four hermit crabs, three other crabs, several teleosts and a squid have been found in their stomachs.

Newts and frogs are common. Many tortoises, snakes, water and land birds and mammals are seen by the most casual observer.

I am indebted to Dr. D. S. Johnson, instructor at the Laboratory, for the following description of

THE FLORA ABOUT COLDSPRING HARBOR.

The physiographic conditions of this region are considerably varied, as has been noted above. On the outer coasts of the north side of the island are extensive sandy beaches, almost or completely washed over by the sea during hard storms.

* Chiefly by Mr. Francis B. Sumner.

Just above the reach of the ordinary tides these beaches are partially covered with *Spartina juncea* interspersed with *Rhus toxicodendron*, *R. copallina* and *Lathyrus maritimus*, while *Arenaria peplodes Salsola kali*, *Cakile maritima*, *Opuntia Rafinesquii* and *Solidago sempervirens* are among the other halophytes and xerophytes met with. *Juniperus Virginiana*, *Myrica cerifera* and *Prunus maritima* are the only considerable shrubs found here.

On the more barren spots farther from the spray numerous tufts of *Hudsonia tomentosa* and *Cladonia rangiferina* are interspersed with *Geasta* and other *Cladonias*. Several other species of lichens and several woody toadstools are found on the stems of the dead clumps of *Prunus*.

In the quiet mud-bottomed pools a hundred yards back from the outer beach, which are flooded at high water by salt creeks, *Spartina polystachya* forms thick growths, along the edge of which grow *Salicornia*, *Buda marina* and several genera of *Schizophyceæ* with many green and red algæ.

Farther in from the Sound the shores of the Harbor are scattered with boulders on which are found many rock-bearing algæ. Among the Chlorophyceæ, *e. g.*, *Bryopsis* and various species of *Cladophora* and *Enteromorpha* are found; while the Phæophyceæ are represented by such genera as *Ectocarpus*, *Sphacelaria*, *Punctaria*, *Chorda*, *Mesogloia*, *Fucus*, *Ascophyllum* and *Sargassum*; and such genera of the Rhodophyceæ as *Chantransia*, *Nemalion*, *Ceramium*, *Callithamnion*, *Griffithsia*, *Polysiphonia* and *Chandriopsis* are abundant at or just below the lower side-mark. On the beach near these boulders several interesting fresh-water algæ are found growing in springs which flow from the top of a stratum of clay just at high-water level.

In the quiet brackish covers near the inner end of the harbor *Chondriopsis*, *Grinnellia*, *Dasya*, *Rhabdonia* and *Gracillaria*, with various species of *Ceranium* and *Polysiphonia* are very abundant, as are also the species of *Monostroma*, *Ulva*, *Enteromorpha* and *Cladophora*.

In the ponds at the upper end of the valley occupied by the harbor, fresh-water algæ are present in great abundance and variety. Besides several unusual species of Schizophyceæ, such genera as *Pandorina*, *Volvox*, *Oedogonium* and *Bulbochæte* are of frequent occurrence. In the springs and pools on the edges of these ponds an unusually large number of genera of desmids are present and *Batrachospermum* is occasionally found. Many interesting hydrophile phanerogams are also present in these ponds.

It is in the dense woods surrounding these ponds that we find the most interesting feature of the whole region. These woods are chiefly of oak, chestnut, beech and birch, with an undergrowth of *Clethra* and *Hamamelis* in the damper portions and of *Kalmia* in the drier ones. The damp soil and air make exceptionally favorable conditions for parasites and saprophytes. Such forms as *Cuscuta*, *Monatropa* and *Corallorhiza* are abundant, while the variety and abundance of the Myxomycetes and Fungi are quite remarkable. Fifteen genera of Myxomycetes, six of them new to the island, have already been noted and many new species of the more common genera will probably be found when the study of the region can be carried beyond the limited territory already visited. Among the Fungi the Pyrenomycetes, Hysteriaceæ, Discomycetes and Helvellaceæ of the Ascomycetes, and the Hymenomycetes, Phalloideæ and Gasteromycetes of the Basidiomycetes, are represented by large numbers of both individuals and species.

In conclusion a few words may be added concerning the value of the laboratory at Coldspring Harbor as a center for the study of localities other than that of the Harbor

itself. Long Island Sound is easily reached from the laboratory and excursions have been made on the launch of the laboratory to the rocky shores of Connecticut. A two hours' ride on the bicycle over good roads brings one to the Great South Bay, which contains certain oceanic animals not found at Coldspring, *e. g.*, *Cyanæ*, *Aurelia* and *Zygodactyla*. This great bay is almost a new field for the biologist. The few attempts at dredging there, made during the past season, indicate that it will be a fruitful field for exploration. Finally, the eastern end of Long Island, with its extensive bays, can best be studied from the Coldspring Harbor laboratory as a base.

The general outlines of our fauna and flora are already sketched. This much knowledge is necessary as a basis for further work, whether in the way of instruction or in the way of research in anatomy, embryology or physiology, or in such systematic study as shall reveal more completely the kinds of organisms living here and the conditions which determine their occurrence.

CHAS B. DAVENPORT.
COLDSPRING HARBOR, August 8, 1898.

THE NERNST LAMP.

THE *Frankfurter Zeitung* contained recently a very interesting account of Professor Nernst's new electric lamp. As information on this subject has heretofore been so difficult to obtain, a brief abstract from this article may be of interest to the readers of SCIENCE.

As has been previously announced, Professor Nernst employs magnesium oxide for the illuminating material which at ordinary temperatures is a non-conductor, but when heated to a sufficiently high degree (and herein lies Professor Nernst's discovery) becomes a perfect conductor and emits a brilliant white light. The preliminary heating of the magnesia (*A*) Professor Nernst accomplishes by placing it in the focus of a reflecter (*C*) as seen in Fig. I. On the inner side of the reflector is a spiral wire of

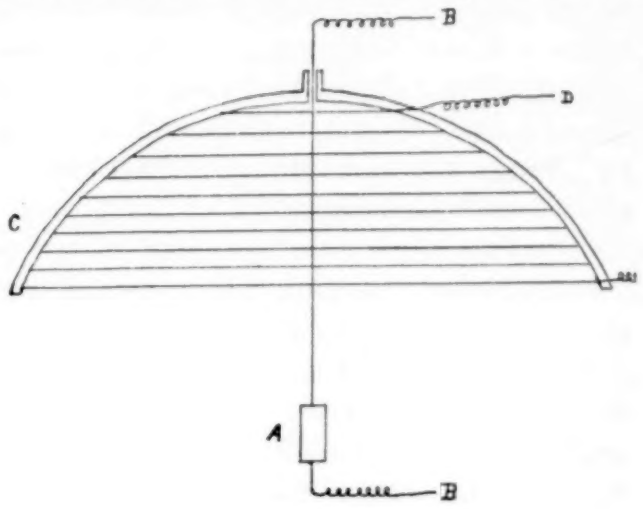


FIG. 1.

platinum (*D*) which, when brought to incandescence by a current, produces heat sufficient to render the magnesia a conductor; a current is then passed directly through the oxide by the wire (*B*) and that in the spiral is shut off. A complicated form of lamp is seen in Fig. II. Here the magnesia (*A*) is placed within a cylinder (*C*), which also incloses a platinum spiral (*D*). As soon as the incandescent spiral has heated the magnesia

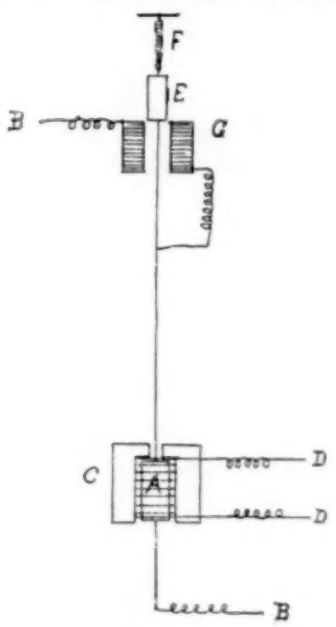


FIG. 2.

sufficiently a current is passed through the oxide by the wire (*B*). Within this circuit is a coil (*G*) which upon becoming magnetic draws down the iron bar (*E*), thus lowering the now incandescent magnesia from within the cylinder. Upon breaking the circuit the coil loses its magnetism, and a spring (*F*) raises the iron bar and magnesia to their former positions.

As advantages over the ordinary incandescent lamps Professor Nernst claims that the same amount of light can be furnished at one-third the cost, and as the magnesia allows of being heated to a much higher degree than a carbon filament a purer light is obtained. The successful employment of a cheaper substitute for the platinum is also announced, though the name is not made public. In operating, either an alternating or direct current is used.

H. Monmouth Smith.
Hampden-Sidney, Va.

BOTANY AT THE ANNIVERSARY MEETING OF THE AMERICAN ASSOCIATION.

II.

The Biology of Cheese Ripening. Professor S. M. Babcock and Dr. H. L. Russell.

The most important changes which occur during the ripening of cheese are those which affect the casein, this being gradually transformed, from the firm, elastic and insoluble conditions found in a green cheese, into the plastic and more or less soluble substance peculiar to a well-ripened product. The early explanations of these changes were purely chemical, but since the discoveries of Pasteur and others in the field of fermentation they have been attributed entirely to bacteria and other micro-organisms. Duclaux suggested that the changes in the casein were due to digesting organisms. Later observers have shown that such organisms fail to develop in competition with the lactic acid type of bacteria, which are by far the most prominent species found in normal cheese. This type appears to be unable to digest casein to any considerable extent when grown in sterilized milk, unless their activity is greatly prolonged by neutralizing the acid as it is formed, in which case again the conditions do not conform to those found in normal cheese. Moreover, the ripening changes in cheese progress at a nearly uniform rate for a long time after bacterial development has greatly declined. The authors of this paper were unable to reconcile the many apparent discrepancies of the biological theory of cheese ripening until they attempted to sterilize milk for their experiments by the addition of mild antiseptics, such as ether and chloroform, which could afterwards be removed and thus avoid changes which might be produced by boiling the milk. Such milks, although sterile, passed through changes similar to those that occur in cheese. As the agents used in this case discriminate between organized and unorganized ferments, it is evident that milk contains an unorganized ferment capable of digesting casein. This enzyme is inherent in the milk itself. The authors have given to this ferment the name *galactase*, and they believe it plays an important rôle in the proteolytic changes that occur in the ripening of cheese.

Fermentation without Live Yeast Cells. Katherine E. Golden and Carleton G. Ferris.

This paper first summarizes the rather extensive and contradictory literature, beginning with E. Büchner in 1897, who claims to have induced active fermentation of various sugars with a sterile extract obtained from dried yeast by filtration through a Berkefeld filter. Büchner's method was followed in the preparation of the yeast. In filtering, the fluid was first passed twice through three thicknesses of

filter paper, and then through two thicknesses of parchment paper. The filtered fluid appeared clear and opalescent, but on microscopic examination live cells were found. A filter was then made by putting two thicknesses of filter paper in a glass funnel and coating with about ½ inch of gypsum. The funnel was then fitted into a flask and the whole sterilized. The filtrate from this was clear, but also contained a few live cells. The filtrate remained clear for three days and then became clouded from growth of yeast and bacteria. The same results were obtained from a gypsum filter an inch thick. A porous cup was then used with an aspirator to hasten filtering. Using this filter a sterile extract was obtained. This was tested in 10 and 20 % cane sugar, dextrose and wort solutions, but no fermentation took place in any of them. The experiment was repeated three times and at 37.5°C. as well as at room temperatures, with negative results in every case. The experiments were then repeated with another compressed yeast which also gives vigorous fermentation, but with negative results in every case. Inasmuch as Büchner now states that only certain yeasts possess this property, it is desirable that he should name and describe the yeast or yeasts which he used.

Deterrent Action of Salt in Yeast Fermentation. KATHERINE E. GOLDEN.

THESE experiments show that sodium chloride in any but minute quantities retards fermentation and indicate that where a sponge is used, and a quick fermentation desired, the salt should be added in the last stages. Experiments were made on sponges and stiff doughs at three temperatures, 23°, 37° and 40°C. The following table shows the increments of fermentation in inches, by half hours, in long test-tubes, the temperature being negligible:

No. of Exper.	Per cent. of salt added.	Increments of fermentation in inches.			
		½ hour.	1 hour.	1½ hours.	2 hours.
a	0	.666	1.375	1.708	1.583
b	1	.542	1.292	1.625	1.625
c	2	.456	1.200	1.500	1.666
d	3	.354	.958	1.375	1.375
e	4	.313	.875	1.250	1.375
f	5	.146	.292	.438	1.666

Experiments in fermentation tubes, using 25 cc. volumes of Pasteur's solution with cane sugar, and equal quantities of yeast (1 gram of dry yeast cake) and varying quantities of salt, gave the following results: In the control tube the fluid was driven from the closed end in 23 hours; with 4% salt the fluid was driven out in 37 hours; with 8% salt, in 38 hours; with 12% salt, in 47 hours; with 16% salt, in 7 days.

Leaves of Red Astrachan Apple immune from the Attack of Gymnosporangium Macropus. PROFESSOR W. J. BEAL.

RECORDS failure of disease to spread from infested cedar trees to two young Astrachan apple trees, purposely planted near, and also negative result of several inoculation experiments, all made in 1897. In 1898 experiments were repeated with same result. States that Professor L. R. Jones, of Vermont, has had the same experiance.

Notes on Stewart's Sweet Corn Germ, Pseudomonas Stewarti n. sp. DR. ERWIN F. SMITH.

ABSTRACT omitted on account of its length. See Proceedings of the Association; also a reprint from the same.

A Bacteriological Study of Pear Blight. LILLIAN SNYDER.

THE greater part of this paper describes a non-parasitic organism which was found associated with *Bacillus amylovorus* in blighting trees. This organism is white and on solid media its colonies closely resemble those of pear blight. It also resembles the latter morphologically. Both germs grew

slowly in cornstarch cooked in water, and sugar was not formed. Both change cellulose to sugar and the non-parasitic one gives a slow fermentation when the cellulose is made up with peptone. In pure moistened cellulose the growth of both was very slow and sugar was not formed in either case. Both prefer high temperatures. It differs from the pear blight germ in the following ways: Feeble growth in healthy tissues and no symptoms of blight (young twigs and unripe fruits of the pear and quince). In unripe fruits it was alive at the end of ten days and in some cases had extended to the opposite side of the fruit and into the seeds. Mixed in water in equal parts with the pear blight germ and inoculated into twigs, blight ensued, but when the tissues were examined, at the end of ten days, only *B. amylovorus* was found, although several attempts were made to isolate the other germ.

Unlike pear blight, it ferments potato broth, pear broth and cane-sugar solution, with a copious evolution of gas. A large fermentation tube of Smith's solution yielded about 200 cc. of gas in 10 days. This consisted of 6.2% nitrogen, 61% carbon dioxide and 32.8% hydrogen. The growth in broth made by cooking unripe pears in water was slower than that of *B. amylovorus* and in 48 hours the fluid became a deep green. In peach broth made in the same way the same deep green color appeared and zoogloeæ were quite abundant. The writer has not been able to discover zoogloeæ in cultures of the true blight bacillus. In potato broth this germ grew much more rapidly than *B. amylovorus* and gas production began in a few hours.

This organism is best obtained by placing pieces of tissue in bouillon. The same or a similar germ was also obtained by washing the surface of healthy twigs into bouillon or Smith's solution. One which turned pear broth green was also obtained from the surface of grains, especially wheat. By means of platinum needle transfers from the interior of freshly blighted twigs the true bacillus of the blight may be separated with less danger of contamination. The fact that this germ does not apparently injure the trees when inoculated into them, also that it is obtained by washing the surface of healthy twigs, proves that it has no essential connection with the disease, and renders it probable that it is a surface germ. This work was carried on in the laboratory of Dr. J. C. Arthur, at Purdue University.

Life History and Characteristics of the Pear-Blight Bacillus. Merton B. Waite.

Beginning in the spring, the germs on the new growth first appear on the nectar disks of the blossoms. The bacilli live and multiply in the nectar and are able to enter the nectar glands without a puncture or injury, and thus normally get inside their host. The distribution from flower to flower and tree to tree is through the agency of insects, mainly flower-visiting sorts. Infection also occurs on the young shoots, and less frequently on the fleshy bark through injuries. Insects and birds are agents of distribution and inoculation in these cases. No evidence has been found that the germs are carried by the wind. The organism usually dies out in the twigs which are blighted and dead, but in certain cases the germs manage to keep alive during the summer by making slow progress in the fleshy living bark. Such cases may succeed in living over winter. Winter weather is favorable to the longevity of the organism, on account of the moisture and low temperature. These cases of 'hold over blight' start off again in spring and exude quantities of gummy matter full of the bacilli. This is visited by insects, especially flies and wasps, and is carried onto the newly opened flowers, thus completing the cycle of the year. In brief, the characters of the germ are as follows: An

oval, rod-like bacillus, 0.6 to 0.8 by 1 to 6 μ, constant in diameter, but varying greatly in length. Occurs singly, or in young cultures in pairs, chains or masses. Stains readily with the ordinary aniline dyes, either in water or alcoholic solution. Has no capsule, but is supplied with several flagella scattered over the surface and is actively motile. Does not produce spores. On nutrient beef and potato broth produces first a strong turbidity and a slight granular pellicle, which breaks up and settles to the bottom. The color of the mass is milky white on all solid media. On agar plates the surface colonies at ordinary temperatures (18° to 20° C.) reach a diameter of about 1 mm. in 48 hours and at the end of a week become 5 to 6 mm. across. A temperature of 36° to 37° C. starts the growth more promptly, but results in a feebler ultimate development. The addition of malic or citric acid in small amounts so as to feebly acidify the agar increases the vigor of growth, while an excess of alkali diminishes it. On gelatine made from the common brands the opposite effect is produced. Gelatine should be neutral to phenolphthalein to insure vigorous development. There is a moderate liquefaction in good gelatine cultures. A moderate growth is made on sterile cooked potato cylinders. In the fermentation tube it decomposes sugar without the formation of gas. It is most vigorous with maltose, the cultures becoming strongly acid, and is slightly less so with cane sugar, dextrose and laevulose. It is aerobic and facultative anaerobic. It produces no pigment or coloring matter of any sort, and no odor. It does not decompose starch. Its principal food consists of nitrogenous matter, sugars and probably to some extent certain organic acids—to wit, the substances found in young growing tissues of its host. Certain statements formerly made are known to be erroneous. The germ mass was said to be yellowish-white on potato. This could only come from an impure culture, as the true pear-blight germ is always white. Gas, or in some places carbon dioxide gas, is said to be formed. This never occurs. Butyric acid is said to be one of the products of its decomposition. The germ produces acids, but never butyric. Starch is said to be decomposed and used as food, but, so far, the author has not been able to demonstrate this. The germ is said to live over winter in the soil. The author has failed to find it in the earth, and its life cycle is complete without such hypothesis.

On the Occurrence of a Yeast Form in the Life Cycle of Sphæropsis malorum. PROFESSOR WM. B. ALWOOD.

PAPER records the discovery of a yeast form in laboratory cultures of this fungus. On isolation and inoculation on the fruit of the apple the common fruit bodies characteristic of *S. malorum* made their appearance.

Some Steps in the Life History of Asters. PROFESSOR EDWARD S. BURGESS.

THIS paper presents results of field-studies of Aster variations made during the last twelve years. Its purpose is to review certain known terms in the ontogeny of Asters which are liable to misinterpretation. These sources of confusion are of three classes, the first of which is the number of leaf-forms normally developed at once upon a single stem. There are eight principal forms:

a. Primordial leaf, usually roundish and transient.

b. Radical leaves, two or three or more, often progressively different.

c. Lower cauline leaves, usually the most characteristic.

d. Middle cauline leaves, usually transitional in shape.

e. Upper cauline leaves, usually much smaller.

f. Axile leaves, subtending the primary axils.

g. Rameal leaves, on primary branches.

h. Bractlets, on the ultimate branches.

According as one or the other of the parts of this leaf-series is more strongly developed, or is suppressed, the plant will change aspect and may be mistaken for a new species. The other two sources of confusion now to be considered are the normal and the accidental, or less usual successive terms in the life-history of the species. These are here treated together, distinguished by number and letter, the normal or usual by the letter *N*, the accidental or less usual by the letter *A*.

N^1 Seedling stage, usually with two small radical leaves.

N^2 Radical-tuft stage, often conspicuous, often remaining some years before developing into N^3.

A^1 Oval-topped stage, frequent in Biotian Asters, the normal cordate radical tuft becoming topped out with the smaller, thinner, oval or other non-cordate leaves.

A^2 Plantain-leaf stage, an occasional extreme development from the last, the non-cordate leaves becoming the predominant ones, and often resembling *Plantago major* in size and shape.

N^3 Cauline stage, normally following N^2, the radical tuft sending up an erect leafy stem which bears six of the eight leaf-forms already mentioned. But instead of taking this normal course of development, the plant may enter upon any one of the following seven stages which are enumerated as accidental or less usual.

A^3 Intercalary stage, when one or more little leaves are interpolated into the series with much larger leaves above and below.

A^4 Arrested stage, when the gradually diminishing normal series of cauline leaves meets sudden arrest from which it never recovers, a succession of little leaves now continuing into the inflorescence.

A^5 Sprout form, usually with leaves somewhat different in form and size from the type.

A^6 Ramified or branch-leaf form, when, after suppression of the main stem, one or more branches rise to replace it, with new direction, and the leaves larger and more numerous, but the leaf-form remaining true to the branch-leaf type for that particular species.

A^7 Bifurcation, either in leaf or stem, arising apparently not from accident, but as a sport.

A^8 Opposite leaf state, due to suppression of internodes, especially upon abnormal branches.

A^9 Verticil form, three nodes brought together in inflorescence or rarely in the leafy stem.

N^4 Aestivation, the budding stage; often a very different aspect is taken here from that before or after.

N^5 Flowering stage, beginning with erect terete rays, which are soon tubular by involution, and in anthesis may change greatly, according as the following progressions become developed or not:

a. Pedicels lengthen, changing sessile buds into long-pedicelled flower-heads, and dense branches into loose clusters.

b. Cymose development may prolong the outer branches so as to overtop the central and original inflorescence.

c. Rays flatten across, becoming flat and rounded.

d. Rays change position from erect to horizontal, and finally recurved, incurved or pendulous.

e. Rays change color with age to white, greenish or brownish.

f. Disks change color early from yellow to red, reddish-brown or brownish.

g. Disks change from flat to dome-shaped.

h. Pappus changes color by yellowing, darkening or reddening.

A^{10} Enfeebled state, after close cutting

down; when the new stems rising from the same root-stocks the next year are often shorter, weaker, scantier and paler in inflorescence and less varied in leaf.

N^6 Resting stage, when, instead of the preceding (N^5) or after it, the root-stock develops radical leaves only for a series of years.

N^7 Surculus stage, a lateral offshoot, arising from the preceding root-stock, rising and making ready to enter upon the radical-tuft stage, N^2, and renew the round of the life-history.

Specific distinctions are hardly to be found in the constant absence or presence of any of the less usual stages, but rather in the relation the plant bears to them when they are found, the ease with which they are induced or thrown off, and the shapes assumed when induced. Some species habitually elide one or more terms in the series, some accelerate them, some prolong or accentuate them. An exceptional development does not invalidate a specific character, as its possibility is latent in all.

The Embryology of Taxus. E. J. DURAND.

IN this paper the development of the female prothallium is traced from one of an initial axial row of about three cells. The nuclei which result from the division of the nucleus of the macrospore arrange themselves in a peripheral layer, and walls are formed between them so that the young prothallium is in the form of a hollow sphere, the center of which gradually becomes solid from the ingrowth of the cells. The archegonia are developed at the distal end of the prothallium. The neck of the archegonium consists of four cells, instead of one, as is usually stated for this plant.

Effect of Fertilizers on the Germination of Seeds. GILBERT H. HICKS.

THE tests were made with the seeds of wheat, lettuce, radish and crimson clover. The conclusions reached are as follows:

1. One per cent. strengths of muriate of potash and of sodium nitrate are very detrimental to seeds, whether applied directly or mixed with the soil.

2. Fertilizers composed of phosphoric acid or of lime are much less injurious to germination, and if not used in excess may be harmless.

3. Commercial fertilizers should not be brought into direct contact with germinating seeds.

4. The effect of treating seeds with chemicals before planting is no index to the action of those chemicals when applied as manures to the soil.

5. The chief injury from chemical fertilizers is effected upon the young sprouts after they leave the seed coat and before they emerge from the soil, while the seeds themselves are injured only slightly or not at all.

6. It is highly improbable that potash, phosphoric acid, nitrogen or lime used as fertilizers actually favor germination.

The Pleistocene and Plant Distribution in Iowa. DR. T. H. MACBRIDE.

THIS paper offers a new explanation for certain peculiarities of distribution characterizing the flora of that prairie State. It appears that certain plants, especially northern species, are not only very rare in Iowa, but are in their distribution limited to very small and far-separated areas. No existing conditions seem to offer any explanation. Recent study of the pleistocene geology of the State brings to light, however, the fact that these isolated stations for Iowa's rarer plants are all of them *driftless* areas, *i. e.*, areas entirely exempt from glacial deposits. So remarkable is the coincidence that we may confidently say that wherever the geologist finds a driftless hill-top there certain plants are sure to occur and *vice versa*. The paper was illustrated by a map.

Observations on some Hybrids between Drosera intermedia and Drosera filiformis. Professor John M. Macfarlane.

The author reported the discovery and described the appearance of a number of Droseras which are morphologically intermediate between the species named, in number and position of the flowers, number and shape of the leaves, scales, etc., so that he thinks there can be no reasonable doubt as to the occurrence of hybrids between these two species. Drawings were exhibited and explained.

On the Validity of the Genera Senna and Chamæcrista. Charles L. Pollard.

A record of further observations on the structure of the flower of *Cassia Chamæcrista*, on the floral arrangement of which Professor E. L. Greene commented in a recent issue of *Pittonia*. He found that the corolla exhibits a torsion of 90° to the left and thereby differs materially from that of *Cassia* proper. Other characters were adduced to prove the distinctness of the two genera.

Species Characters among the Violets. Charles L. Pollard.

Development of the Pollen Grain in Symplocarpus and Peltandra. B. M. Duggar.

Division of the primitive archesporium is of the vegetative type, and the number of chromosomes present is that of the whole number of the sporophyte. The resting nucleus of the definitive archesporium has a large nucleolus taking the chromatin stain in the Flemming combination. The reticulum is a loose net very slightly chromatic. In the cytoplasm there is no differentiated zone of kinoplasm. The contracted state of the chromatin thread in the late reticulum or early spirem was found abundantly at a definite period in the life-history of these cells prior to actual division. In this condition staining is difficult, and the return from this phase is characterized especially by a loosening of the ribbon in one perfect coil, thus truly imitating the spirem. The spirem ribbon becomes nodulate, and finally segmentation is preceded by a bending back of the ribbon at definite points and the disappearance of the chromatin along the connecting linin. The formation of the spindle is multipolar and the chromosomes are centrally as well as peripherally arranged. The nucleolus is peculiar in assuming various shapes and in showing linin connections with the general ribbon. The first division, in general, indicates that there is a longitudinal division of the chromosomes, although in Symplocarpus there is a suggestion that the first division may be the reducing division and hence transverse. In the second division the daughter segments separate longitudinally in both cases. There is no return of the nucleolus prior to the second division, but a true dispirem is formed. This is in accord with studies on Liliaceæ, but differs from what is found in some dicotyledonous plants. In the division of the microspore nucleus the nucleus migrates to one side of the cell and the entering kinoplasm forms a multipolar somewhat barrel-shaped spindle. This finally becomes completely attached at one pole, forming a truncated cone, while the other pole of the spindle may be truly conical. This fixity of the spindle causes the unequal division of the cell body, necessitating the small generative cell. This method of division (fixity of one pole) seems to be characteristic of such divisions in many plants.

Notes on the Embryo-sacs of Certain Monocotyledons. K. M. Wiegand.

Recent investigations by Dr. Wiegand tend to show that the two extreme types of embryo-sac formations as illustrated by *Lilium* and *Canna* are related in a manner not before observed. In *Convallaria*, which represents the transitional type, a septum is formed after the first division of the hypodermal nucleus, but not after the second.

This represents an axial row of four cells with two septa omitted. The remaining septum at length breaks down, so that a single cavity containing eight nuclei results. The single cell of *Lilium* is, therefore, derived from the four axial cells of *Canna*, not primarily through the omission of any divisions of the mother cell, but by the absence of the septa.

Studies Relative to the Perigynium of the Genus Carex. K. M. WIEGAND.

THREE theories have been advanced as to the homology of the perigynium in the genus *Carex*. By Bentham and others it was considered to be composed of two united bracts. Schleiden considered it to be a modified perianth; but the most plausible theory is that advanced by Pax, Dyer and Kunth, who emphasize the fact of its close resemblance to the prophyllum of other monocotyledons. In many cases the secondary axis within the perigynium develops to such an extent that several rudimentary flowers are formed in addition to the fertile one. The perigynium is, therefore, not a perianth. The position of the odd carpel, which is turned toward the main axis of the spike, and the development of the perigynium from two posterior teeth, seem to indicate that the perigynium is, indeed, a modified prophyllum.

Rapidity of Circumnutation Movements in Relation to Temperature. E. SIMONS and R. E. B. MCKENNEY.

FIVE species were experimented with, viz.: *Phaseolus vulgaris, Humulus lupulus, Convolvulus sepium, Lonicera brachypoda* and *Wistara sinensis*. Darwin also experimented on these plants, but gives few exact details as to temperature. The average there in England is 15° or 16° C. in spring and 20° to 23° C. in summer. In this paper no account is taken of the relative intensity of the light, although data are being gathered which prove that this is an extremely important factor. In dull cold days, with temperature at 15° to 19° C. movements were found to be *extremely* slow. The average optimum for best results was 28° C. In *Convolvulus sepium* two distinct types of stem were observed, a rapidly circumnutating and a prostrate one showing extremely feeble movements. In the results obtained by the writers it is safe to assume that the temperature was on the average 12° C. higher than that worked in by Darwin, and in most cases the periods of revolution are very considerably shorter, but at present it would be rash to say that the higher temperature is the sole or even the main determining factor in the more rapid movement. Light intensity and hygrometric conditions of the atmosphere have been found to cooperate also, but present indications are that temperature is a very important factor, and that an optimum as well as a maximum and minimum temperature exist for each species.

General Characteristics of the Duneflora of Southeastern Virginia. THOMAS H. KEARNEY, JR.

REPORT of a preliminary survey of the plants of the coastal plain with reference to their ecological distribution. The soils, heat, light and other physical conditions were first described. The principal plant groups were thus described with an enumeration of some of the more evident adaptations by which the plants were brought into harmony with the physical conditions.

Vegetation of the Wooded Fresh-water Swamps of Southeastern Virginia. THOMAS H. KEARNEY, JR. (Read by title.)

Notes on Arctic Willows. PROFESSOR W. W. ROWLEE.

THE Cornell party on the Peary expedition of 1896 brought back an exceptionally good collection of willows on which this paper is based. The glaucoid and myrtilloid

groups, which are perhaps the most difficult to segregate, have several interesting forms. This paper attempts to characterize the forms of *Salix glauca* L. and *S. grœnlandica.*

A Self-registering Transpiration Machine. Edwin B. Copeland.

Description of a very simple and easily operated apparatus, consisting of a wheel over which runs a string carrying the plant tested on one end and an areometer on the other. As the plant loses weight, the counter weight, the areometer sinks. The record is kept as with an auxanometer. One day's record was presented to illustrate the working of the machine. To be published in *The Botanical Gazette.*

Methods of Studying the Sap Pressure of the Sugar Maple. Professor L. R. Jones.

After some unsatisfactory experiments with the common mercurial gauge, a self-recording steam-pressure gauge (which was exhibited) was substituted with very good results. Lithium passed upward and downward in the maples very rapidly, but there was very little sidewise movement of this substance.

Notes on the Physiology of the Sporophyte of Funaria and Mnium. Dr. Rodney H. True.

The growth rate of the sporophyte of these mosses may be represented by a rather flat curve rising somewhat more gradually than it falls. Subsequent to the breaking loose of the calyptra from the gametophyte, growth is confined to the distal end of the sporophyte, and the growing region, about 2 mm. long, is entirely enclosed by the calyptra.

The calyptra, much developed in *Funaria,* less so in *Mnium,* is a protective structure chiefly useful in preventing desiccation. In *Funaria* the cells of the calyptra are living and contain chlorophyll grains. They are probably self-supporting as regards nutrition until the rupture of the calyptra.

The curvature of the seta in this species results as a response to the stimulus of gravitation. In the earlier stages of its growth the seta is not sensible to this stimulus, but becomes so as the time for the development of the capsule approaches, and by use of the mechanism of growth executes the curvature.

The direction of the strongest illumination determines the radius in which the capsule shall fall. In *Mnium* the capsule falls with great regularity away from the direction of the strongest illumination, thus exposing the end of the capsule bearing the stomata to the light. Occasionally some fall directly toward the strongest light, but very rarely out of that plane.

Funaria obeys, with much less precision and regularity, the same rule. The conduct of these mosses varies in accordance with the nature of the situations which they are wont to occupy.

The Seeds and Seedlings of some Amentiferæ. W. W. Rowlee and Geo. T. Hastings.

As compared with the other groups of angiosperms the Amentiferæ have been, so far as their seeds and seedlings are concerned, very indifferently observed. Finding this to be true led the authors of this paper to grow seedlings of the native representatives of the group. Their studies have led to the following conclusions: 1. The cotyledons in *Juglans* and *Hicoria* correspond with the valves of the nut, and are deeply two lobed. The two divisions of the embryo resembling cotyledons are each made up of halves of the cotyledons. 2. The seeds of *Hicoria* germinate without frost action; those of *Juglans* only with frost action. 3. The tap-root is very thick in young seedlings, and very long in in older ones. 4. In *Castanea* and *Quercus* the shell is split by a swelling of the coty-

ledons in germination. 5. In the species of *Quercus* studied, the leaves of the seedlings were much alike, and not deeply cut or lobed. 6. *Fagus* is the only genus in which the hypocotyl lengthens, or the cotyledons become aerial.

The paper was illustrated by two plates; one showing the peculiar division of the cotyledons in *Juglans* and *Hicoria*, the other various seedlings of the group.

The Morphology and Taxonomic Value of the Fruits of Grasses. P. BEVERIDGE KENNEDY.

THE presence of an epiblast and a plumule sheath distinguishes the embryo of the Gramineæ from that of other monocotyledons. About eighty genera were investigated to determine the constancy, morphological significance and taxonomic value of these peculiar organs. In general, species of the tribes Maydeæ, Andropogoneæ, Zoysieæ and Tristeginæ are without epiblasts, while those of the tribes Oryzeæ, Agrostideæ, Aveneæ, Chlorideæ, Phalarideæ, Festuceæ, and perhaps the Bambuseæ possess epiblasts. Peculiar exceptions occur in some tribes, *e. g.*, the Hordeæ appears to have equally as many with as without epiblasts. From study of the perfectly developed epiblasts in *Zizania*, *Leersia* and *Oryza* the author is led to believe that the epiblast is a second rudimentary cotyledon opposite to the scutellum (cotyledon). The plumule sheath is constant in all embryos, and from his study of the vascular system, together with Hanstein's investigations on the development of the embryo of Brachypodium, the author believes that it is a ligule-like growth belonging to the scutellum and is homologous with the ligule of the fully developed grass leaf. Unlike Bentham and Haeckel, he is inclined to believe that the Bambuseæ and Oryzeæ together represent the most primitive grasses. The Oryzeæ resemble the Bambuseæ as follows: 1. They show great variation in the structure of their fruit and spikelet. 2. They possess remarkably large epiblasts. 3. Some have the same number of lodicules. 4. *Pharus* has a style with three stigmas. 5. Many of the genera have broad petiolate leaves and transitions between these into linear leaves. 6. To a great extent they have the same geographical distribution, the larger number of the genera being indigenous to tropical America. According to Haeckel's classification, the tribes Zoysieæ, Tristeginæ, Andropogoneæ, Maydeæ and Paniceæ, both according to the characters of the fruit and those of the inflorescence, form another natural group joined to the Oryzeæ through Zoysieæ and Tristegineæ. The Chlorideæ, although regarded by Haeckel and Warming as being removed some distance from the Andropogoneæ, have been found like them in their fruit characters. Judging from their fruit characters, the remaining tribes, Phalarideæ Agrostideæ, Aveneæ, Festuceæ and Hordeæ form another natural group in the order named, and this coincides with the classification given by Haeckel.

To avoid a session Thursday evening, the following papers were read by title:

The Caryopsis of the Gramineæ. PROFESSOR L. H. PAMMEL.

The Ecological Distribution of Colorado and Wyoming Plants. PROFESSOR L. H. PAMMEL.

Fertilization of the Muskmelon Flower. PROFESSOR WM. F. RANE.

Notes on Destroying Comptonia asplenifolia. PROFESSOR WM. F. RANE.

Length of Time from Blossoming to Seed Development in Leucanthemum vulgare. PROFESSOR WM. F. RANE.

The Work Performed by the Agricultural College toward a Botanical Survey of Michigan. PROFESSOR W. J. BEAL.

SEVEN additional titles appeared on the

preliminary program, but were omitted from the regular program because no abstracts were furnished.

Erwin F. Smith,
Secretary.

SURVEYS OF THE GATEWAYS TO ALASKA.

A beginning has at last been made in the accurate mapping of the delta of the Yukon, one of the great rivers of the world. Through the courtesy of Superintendent Pritchett we are enabled to give a preliminary account of the work done in that locality during this year and to advert to further operations of the Coast Survey at the head of Lynn Canal, another of the gateways to the interior of Alaska and the British Yukon district.

On June 30th the U. S. Coast and Geodetic Survey party arrived in St. Michael, Alaska, and immediately began preparations for the survey of that part of the delta of the Yukon River bordering on the seacoast.

The prime object of this expedition was to examine the delta of the Yukon River with the purpose of finding out what depth of water exists on the bars in front of the delta and to locate such channels as were found flowing from the mouths of the river into Bering Sea. This problem necessitated the execution of a scheme of triangulation upon which to base the required topography and hydrography.

While the two small steamers required for hydrographic work off the delta were being fitted out by a section of the party at St. Michael the other members were engaged in triangulating and mapping the coast from St. Michael southward to the the Aphoon (pronounce Ap-hoon) mouth of the Yukon, and in making a detailed survey of the towns of St. Michael, Healy and immediate vicinity. This detail map proved of much value to the military authorities of St. Michael Military Reservation in settling the matter of boundary lines between the commercial companies located there.

The channel and bar of the Aphoon mouth of the Yukon River were surveyed and developed. This is the channel that has always been used by steamboats for getting into the river from St. Michael.

While this work at the Aphoon mouth was in progress another small party had gone on one of the small steamers to the Kusilvak mouth of the river, establishing a latitude and longitude station well inside of the coast line. From this station it proceeded seaward with a topographic and hydrographic survey.

From all reports of the natives and others it seems reasonably certain that the Kusilvak mouth is the deepest of the mouths of the river, and this survey shows that it has much the greatest volume of water.

From the latter part of August to the end of the season the whole party was at work on the Kusilvak mouth of the river and southward along the coast, including and beyond the mouth of the Krypniak River. The Kusilvak mouth was found to be about twenty-five miles farther northwest than given on the most recent charts. All that can now be said of this mouth of the river is that eight feet of water can be carried into it at low tide, whereas there is only two feet at low tide on the bar at the entrance to the Aphoon mouth, the one now used by steamboats plying on the Yukon River.

From the investigations made of the Kusilvak mouth the shallowest water on the bar is from three to six miles off shore and the eight-foot channel is very crooked and difficult to follow with a vessel. It cannot be followed at all except by the constant use of a sounding lead. The use of buoys appears impracticable on account of the outflow of ice each year, which would not only carry the buoys away, but no

doubt change the channel itself in places. It appears that no feasible channel exists in the Kusilvak mouth for vessels of over ten feet draught.

Magnetic and gravity determinations were also made by the party while at St. Michael. The party eft the Yukon delta and returned to St. Michael on September 13th, in order to haul out the vessels before the freezing up of the river, which occurs some time in the atter part of September.

The astronomical observations were obtained only after long waiting because of the continued cloudy weather, while the frequent storms of wind and rain interfered much with the other work in hand.

The hundreds of square miles of mud lying between high and low water of the delta, which was found navigable for neither boats nor boots, presented a problem not usually encountered in surveying. After the low grass flat which lies above the ordinary high water of the delta was finally reached, the surveyors were greeted by myriads of mosquitoes, whose vexatious assaults are the crowning difficulty to be encountered in charting the Alaskan coasts.

Another Coast Survey party charged with the topographic reconnaissance of the headwaters and passes of the Lynn Canal, Alaska, arrived at Haines' Mission on May 7th, where the party separated, one part going up the Chilkat River and the other taking up the work in the Khatschin Valley. Each party was composed of a chief and five men.

The rivers forming the head waters of Lynn Canal have very swift currents and they were ascended under great difficulty and with much loss of time, as the loaded boats had to be tracked the entire distance, the men generally wading in the ice-cold water, overhanging alders precluding shore-tracking, excepting such stretches where gravel and sand-bars are deposited along the river shores. The water level fluctuates with the weather, rising rapidly after a day or two of clear weather, when the snow and ice of the adjoining mountains undergo a rapid melting. The main channels of these rivers change with every freshet, new bars being formed while old ones are washed away. This fact, together with numerous snags scattered about between islands and on sand bars, makes navigation, even with small boats, difficult and risky. The Khatschin party, while descending that river in June, lost one boat and a part of the outfit and records by being wrecked on a snag, the men barely escaping with their lives.

The parties suffered little from rainy weather, but the fogs and mists rarely left the higher altitudes for more than a day at a time, hiding from view the mountains which were to be located cartographically. Owing to the small number of clear days that are generally met with in the mountains of this region, it had been decided to use the photo-topographic surveying method, as it had given good results for the topographic reconnaissance of southeastern Alaska made under the direction of the Alaskan Boundary Commission.

Both parties were supplied with plane-tables for mapping the valleys and photo-topographic outfits. They have returned with instrumental and photographic records, which, when mapped, will cover an area of about 500 square miles, distributed over the valleys of the Chilkat, Tsicku, Tlahini, Khatschin, Skagway and Dyea Rivers, including the tributaries near their heads.

NOTES ON INORGANIC CHEMISTRY.

THE *Chemical News* contains a paper by Robert Meldrum on the action of water and saline solutions on metallic iron. In each experiment six feet of piano wire were exposed in the solutions in a four-ounce bottle. In many of the experiments with

distilled water the water was sterilized, and the author concludes that the oxidation of iron takes place in water in the absence of bacteria and other forms of life, and of ammonia and carbon dioxid. As in no case was air vigorously excluded, the author concludes that it is as yet an open question whether it is the water or the dissolved oxygen which acts upon the metal. In the second series saline solutions were used, alkalies and alkaline salts being experimented with. In general the alkalies prevented action on the iron, but many alkaline salts, as potassium carbonate, hydrogen sodium phosphate, sodium meta- and pyrophosphates and the bicarbonates, do not prevent action. Sodium peroxid had no effect. Alkaline potassium salts act more strongly on iron than the corresponding sodium compounds.

In a recent letter to *Nature*, Sir William Crookes corroborates the observations of Friedlander and Kayser and of Baly, that helium is a constituent of the atmosphere. In examining the more volatile positions from liquid air no difficulty was found in observing the lines of helium. A sample of helium separated by Professor Dewar from Bath gas showed the undoubted presence of neon. The presence of helium in the atmosphere is at variance with the theory advanced, that owing to its great molecular velocity any helium in the atmosphere would escape from the influence of gravitation, unless, indeed, helium is present in space.

J. L. H.

BOTANICAL NOTES.

THE FLORA OF THE UPPER SUSQUEHANNA.

Mr. Willard N. Clute has been studying the flowering plants and ferns of the region drained by the upper Susquehanna and its tributaries, mainly in southern New York, with a small area in northern Pennsylvania, and has brought out his results in the form of a pretty little book of about 170 duodecimo pages. He has not attempted to make a phytogeography of the region, but has given us a local list, which the phytogeographer may profitably take, with similar lists of other regions, in attempting to present a general view of our flora. The book opens with a short introduction, in which there is a little about the topography, geology, rivers and streams, lakes and ponds, bogs and swamps, mountains and ravines, elevations, temperature, rainfall, etc., with brief observations upon the characteristics of the flora, the lesser floras, statistics, etc. No less than 1105 species are catalogued, a very good showing when it is remembered that only Spermatophytes and Pteridophytes are included.

The nomenclature is quite appropriately the modern one, in accordance with the much discussed 'Rochester Rules,' and the families appear to agree with those of Engler and Prantl's *Pflanzenfamilien*, but their sequence is that of the Sixth Edition of Gray's Manual, even to the position of the Gymnosperms, between the Dicotyledons and Monocotyledons. The record of localities given with the species will be of much service to the phytogeographer, for which purpose the citations should have been still more explicit in many cases. The rarer plants fare better in this regard than do those which have a rather wide distribution.

BOMBAY GRASSES.

There has recently appeared from the government printing press of Bombay, India, an important work on the grasses of the Bombay Presidency, from the hand of the lamented Dr. J. C. Lisboa. The region covered extends along the Arabian Sea, from 14½ to 28 degrees of north latitude, or about one thousand miles, and from the coast to an irregular interior line distant from one to three hundred miles, and includes nearly two hundred thousand

square miles of territory. From its latitude the region is seen at once to be distinctly tropical. On our own continent its position is equivalent to the region stretching from northern Nicaragua to southern Texas. In this region Dr. Lisboa found 278 species of grasses, a very good number when we consider that this is a list made in India, and a preliminary list at that.

The general nature of this grass flora may be seen from the following synopsis of the tribes:

Paniceæ,	13	genera,	71	species.
Tristegineæ,	1	genus,	13	"
Oryzeæ,	2	genera,	2	"
Zoysieæ,	5	"	5	"
Andropogoneæ,	21	"	109	"
Maydeæ,	3	"	4	"
Agrostideæ,	6	"	14	"
Aveneæ,	4	"	5	"
Chlorideæ,	8	"	22	"
Festuceæ,	8	"	25	"
Hordeæ,	3	"	3	"
Bambuseæ,	3	"	5	"

It is thus seen that all of the generally recognized tribes excepting the Phalarideæ are represented. The largest genera are *Panicum*, with 30 species; *Andropogon*, with 46; *Ischæmum*, 19, and *Eragrostis*, 17. There is a notable absence of certain of our best known genera, *e. g.*, *Agrostis*, *Bouteloua*, *Poa*, *Bromus*, *Agropyron* and *Elymus*. On the other hand, in addition to those already mentioned, there are species of many of our common genera, *e. g.*, *Aristida*, *Avena*, *Chloris*, *Hordeum*, *Paspalum*, *Setaria*, *Sporobolus*, etc. Some of the Indian species have come to us as weeds or cultivated plants, *e. g.*, *Panicum*, (*Syntherisma*) *sanguinale*, *P. crus-galli*, *P. miliaceum*, *Setaria* (*Ixophorus*) *glauca*, *S.* (*I.*) *verticillata*, *Polypogon monspeliensis*, *Sporobolus indicus*, *Avena fatua*, *Cynodon* (*Capriola*) *dactylon*, *Eleusine* (*Leptochloa*) *mucronata*, *Eragrostis major*, *E. minor*, *E. pilosa*. Two species, viz., *Panicum proliferum* and *Ihragmites communis*, which occur in India, appear to be indigenous to North America also.

It is unfortunate that but 400 copies of this useful list were ordered to be printed by the Bombay government.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA,
LINCOLN, NEBR.

SCIENTIFIC NOTES AND NEWS.

MR. CHARLES A. SCHOTT, Chief of the Computation Division of the Coast and Geodetic Survey, has been awarded the Wilde Prize by the French Academy, which is conferred on the one judged the most worthy from among those who make discoveries in or write works on astronomy, chemistry, geology, physics or mechanics. The award to Mr. Schott is supposed to be based on his work on terrestrial magnetism.

A COURSE of public lectures will be given at Columbia University, between December 5th and 16th, on every afternoon except Saturday and Sunday, by Professor William K. Brooks, head of the department of zoology at Johns Hopkins University. The lectures are to be on 'The Foundations of Zoology,' and while popular in form will present the results of the latest scientific generalizations, together with some account of the men by whom the results in this branch of science have been obtained. The lectures will be given late in the afternoon at Schermerhorn Hall.

THE U. S. Fish Commission Steamer *Fish Hawk* is working, under the direction of Professor Hermon C. Bumpus, in Narragansett Bay and the waters around Block Island. Several questions connected with the breeding habits and distribution of the star fish, and incidentally other problems connected with the marine fauna, are receiving considerable attention. Since the boat has returned from Cuba she has been thoroughly repaired, and is now fully equipped with her customary apparatus for work along the shore line. Lieutenant Commander Richard G. Davenport, of the U. S. Navy, is the commanding officer.

AT a meeting of the Board of Ordnance and

Fortification, on November 10th, it was decided to institute an investigation of the possibilities of flying machines for reconnoitering purposes and as engines of destruction in time of war, and $25,000 of the fund at the disposal of the Board was appropriated for the purpose. The experiments will be carried out under the direction of General A. W. Greely, of the Signal Service, who will have the advantage of the advice of Professor Langley.

Professor J. K. Rees, of the Columbia University Observatory, has received recently, from Miss Catherine W. Bruce, of New York City, means for building a special photographic telescope. This instrument will be mounted at Helsingfors, and will be employed by Dr. Donner to make polar trail-plates for Dr. Jacoby, in accordance with the plan suggested by him lately at the Astronomical Conference in Boston (See Science No. 197, page 451). Miss Bruce also sent Professor Rees funds for carrying on the computing work of the Observatory. Dr. H. S. Davis, in his work on the re-reduction of Piazzi's star catalogue, has been generously aided by the same liberal giver. Most assuredly does Miss Bruce deserve the title of Patroness of Astronomy, for she has scattered her gifts far and wide, but always wisely.

Dr. Calmette, Director of the Pasteur Institute of Lille, has given to that institution a donation of 250,000 francs. The money is to be applied provisionally to the defraying of building expenses till the municipal council is in a position to vote the sums, and is then to be employed in the purchase of material for new researches, or for the maintenance of students making original researches in the laboratory. Dr. Calmette states that his gift represents the profits accruing to him from the application of one of his discoveries in a large distillery at Seclin.

A bronze tablet, with a bust in relief, in memory of the eminent physicist Neumann, who died in 1895, has been unveiled in the Hall of the University of Königsberg, in commemoration of the hundredth anniversary of his birth.

Sir W. H. White, Chief Constructor of the British Navy, has been nominated as President of the British Institute of Mechanical Engineers.

Dr. John William Toore has been elected President and Dr. W. J. Smyly Vice-President of the Royal College of Physicians in Ireland for the ensuing year.

The following is a list of those who have been recommedded by the President and Council of the Royal Society for election into the Council for the year 1899 at the anniversary meeting on November 30th: President, Lord Lister; Treasurer, Mr. A. B. Kempe: Secretaries, Professor Michael Foster and Professor A. W. Rücker; Foreign Secretary, Sir Edward Frankland; other members of the Council, Professor T. G. Bonney, Captain E. W. Creak, R.N., Professor D. J. Cunningham, Professor James Dewar, Professor W. D. Halliburton, Professor W. A. Herdman, Mr. Victor A. H. Horsley, Dr. J. Larmor, Professor N. S. Maskelyne, Sir Andrew Noble, Professor E. B. Poulton, Dr. W. S. Russell, Professor Arthur Schuster, Mr. D. H. Scott, Dr. Stoney and Professor J. J. Thomson.

A statue of Volney was unveiled on October 31st in the French village of Craon, where he was born in 1757. It will be remembered that Volney was a traveler and geographer, though he is doubtless better known for his quasi-philosophical publications and political activity.

The death is announced of Professor Michele Stefano de Rossi, Director of the Seismographic Observatory at Rome.

Mr. Latimer Clark, known for his contributions to applied electricity, died on October 28th. We learn from a notice in the London *Times* that he was born in 1822 at Great Marlow, and gained his first practical experience in railway engineering in 1847, as resident assistant engineer under Robert Stephenson at the building of the Britannia and Conway tubular bridges. Of these he published a description a few years later. He next entered the employment of the Electric Telegraph Company, and from assistant engineer rose to be engineer in-chief. In this capacity he superintended the construction of much of the telegraphic system of Great Britain, and in 1854 introduced the device of pneumatic despatch tubes for the transmission of messages, which

are now extensively used by the Post Office. As a member of the committee instituted in 1869 by the government, in consequence of the numerous failures of submarine enterprises, to inquire into the question generally, he was of great assistance to the cause of oceanic telegraphy, and, in addition to the help he was able to give the committee as an ordinary witness, put in a valuable supplementary report on the determinations of the laws of electric currents in submarine cables, which embodied the results of his own practical experience and experimental work. In 1860 he entered into partnership with Sir Charles Bright, and many of the cable enterprises carried out during the ensuing ten years were under their supervision as consulting engineers. A joint paper by them, contributed to the British Association in 1861, was the means of putting electrical measurement on a firm basis. After it had been read, Sir William Thomson, now Lord Kelvin, obtained the appointment of a committee to devise a national system of electrical units, and the result of its labors was the absolute system now in universal use, the terms volt, ampere, ohm, etc., being adopted according to suggestions made in Bright and Clark's paper. The 'Elementary Treatise on Electrical Measurement,' which has become a standard work, appeared in 1868, and a few years later Mr. Clark, in conjunction with Mr. R. Sabine, published 'Electrical Tables and Formulæ.' In 1873 he described the Clark standard voltaic cell, which has proved of great value in promoting accurate measurements of electrical potentials.

THE plan of appointing a commission to study questions relating to the Colonial Botanical Gardens and Experimental Stations of France, which we noted last week, has been carried into effect, and its scope has been extended to include gardens in France. M. Milne-Edwards, Director of the Paris Museum of Natural History, has been appointed President of the Commission.

THE general committee appointed to commemorate the thousandth anniversary of the death of Alfred the Great have resolved, "That the national memorial decided on at the Mansion-house meeting of March 18th shall be at Winchester and consist of a statue of King Alfred, together with a hall to be used as a museum of early English history." It was estimated that £30,000 would be required for this purpose.

THE United States Civil Service Commission announces that it has received information from the War Department that the necessity for the employment of electrical engineers at New York City and Fort Caswell has practically ceased for the present, and the Commission, therefore, has canceled the examination announced to be held on December 6, 1898. Hereafter the subject of electrical engineering will be an optional subject in junior civil engineer examinations for the Engineer Department at Large (War Department), so that persons qualified as electrical engineers may have an opportunity to have their qualifications tested. The junior civil engineer examination will be given next spring. Applications and information in regard thereto may be obtained after January 15, 1899.

THE position of seed-testing clerk, Division of Botany, Department of Agriculture, will be filled by a civil service examination on December 6th. The chief subject of examination will be practical questions and trials in seed-testing, but the examination will also include structural botany and translations from scientific botanical German into English.

THE International Geodetic Conference met at Stuttgart on October 3d for the first time since its reorganization at Berlin in 1895. Fifteen States of the twenty-two belonging to the Association were represented by official delegates. Probably the most important work accomplished was arranging for the erection and conduct of six stations for the systematic study of variations of latitude. These stations will be at Cincinnati, Dover and Ukiah (Cal.), in the United States; Mizusawa, in Japan; Tschardjoui, in Central Asia, and Carloforte, in Sicily.

FOUR further congresses have arranged meetings in connection with the Paris Exposition of 1900: A congress on railways, a congress on navigation, a congress on the strength of materials and a congress on appliances for

steam engines. The first two congresses are already organized, having held previous meetings. The two latter will hold their first meetings at Paris.

An International Exposition of Horticulture will be held at St. Petersburg from the 17th to the 27th of May, 1899.

The Executive Committee of the National Pure Food and Drug Congress have issued a call for a meeting at Washington on January 18, 19, 20 and 21, 1899.

The annual meeting of the Nebraska Academy of Science will be held on November 25th and 26th, in the Botanical Lecture Room of the University of Nebraska, in Lincoln. Dr. H. B. Ward is the President, and Professor G. D. Swezey, Secretary.

A conference of teachers of chemistry will be held at the University of Michigan, December 27, 1898. This is the sixth of these annual conferences of teachers of chemistry in high schools and colleges. The meetings will continue for two days, the subjects being confined to educational methods and matters. Several reports of committees will be presented for discussion. The program will be sent on request by any member of the Committee of Arrangements, namely: Professor Nef, of the University of Chicago; P. H. Seymour, late of the Detroit high school, and Professor Prescott, of the University of Michigan, Chairman.

The first evening promenade was held at the Royal Botanic Gardens, Regent's Park, November 2d. The string band of the First Life Guards performed a selection of music in the large conservatory, which was illuminated with fairy lamps, and in which there was also a fine show of chrysanthemums. The new club rooms, which will be formally opened shortly, were freely used by the Fellows and members of the Society.

It appears from the final report of the Congress of the Sanitary Institute, held in Birmingham in September, that the number of tickets issued exceeded that of any previous year, and the attendances were in like proportion. The total number of tickets issued was 1,979, as compared with 1,531 at Leeds last year, 1,225 at Newcastle in 1896, and 1,214 in Liverpool in 1895. The number of visitors to the Health Exhibition this year was 85,212, and was 10,000 greater than had been previously attained.

There seems to be a misunderstanding in the medical journals in regard to the usual attitude of men of science toward patents. Referring to the Behring patent of antitoxin in America, a writer in the Berliner *Tageblatt* asked what would have become of the ophthalmoscope if Helmholtz had made a claim to patent his invention. Behring replied that Helmholtz could not do this, because there were at that time no patent laws. The New York *Medical Record* says that Behring traduces the memory of Helmholtz, probably not being aware that it thereby traduces the names of many eminent men of science, including Lord Kelvin and Professor Rowland, who each hold dozens of patents. The question of patents by scientific men is one that deserves consideration and discussion. There is certainly no reason why men of science should not profit from their inventions, but there is a real danger if they undertake to do so lest they may be diverted from scientific to purely technical work. But it is nonsense to speak as the *Medical Record* does of the 'misdeeds' and 'depravity' of Professor Behring. Is not the *Medical Record* copyrighted?

Mrs. Mills, the 'Christian scientist,' who treated the late Harold Frederick in his interest, has been held by a verdict of the Coroner's jury on a charge of manslaughter.

UNIVERSITY AND EDUCATIONAL NEWS.

According to the twenty-fifth quarterly statement of the President of the University of Chicago, there were 1,421 students in attendance during the summer quarter, of whom 591 were in the graduate schools. The assets of the University are valued at about $9,000,000. The income was $706,973 and the expenditures $678,399. An annual report of the University will be published hereafter in the autumn, and the first report to be issued during the present month will contain a *résumé* of the work of the University since its foundation.

The College for Teachers recently established under the University of Chicago, through a gift of Mrs. Emmons Blaine of $5,000 a year for five

years, is not intended to prepare teachers for their profession. The plan is to offer an opportunity to do college work to the 5,000 teachers or more of Chicago. The College will not concern itself with methods of instruction, but only with the subject-matter.

MT. HOLYOKE COLLEGE has received $100,000, bequeathed some time since by the will of the late Charles P. Wilder; one-half of this sum is to be spent in the support and extension of scientific work.

THE new buildings of the medical department of the University of California, built by the State on land presented by the late Adolf Sutro, were formally opened on October 22d. The site, though somewhat remote from the present center of the city of San Francisco, commands a magnificent view, and the laboratories and lecture rooms are excellently equipped.

WE noted last week that eleven architects had been selected in the final competition for plans for the buildings of the University of California instituted by Mrs. Hearst. It appears further that the traveling expenses of these architects are to be paid by Mrs. Hearst in order that they may proceed to California and spend six months in adjusting their plans to the magnificent site of the University.

A CHAIR of physical geography, not yet filled, has been established in the University of Zurich.

THE University of Paris has been given anonymously a fund to allow a French student to study mathematics in Germany.

AT Magdalen College, Oxford, Mr. Horace Middleton and Mr. Harold Hilton have been given fellowships, the former in reference to work in physiology and zoology, the latter with reference to work in mathematics.

M. BOIRAC has been appointed professor of philosophy at Dijon.

THE Council of the University of Paris has nominated for lecturer in experimental psychology as its first choice M. Pierre Janet and as its second choice M. Georges Dumas.

DR. R. LORENZ, electrochemistry, and Dr. K. Keller, zoology, have been made full professors in the University of Zurich.

DISCUSSION AND CORRESPONDENCE.

THE 'BIPOLARITY' HYPOTHESIS.

I HAVE read with interest Dr. Ortmann's remarks in SCIENCE for October 14th on Sir John Murray's views as to the distribution of marine faunas. I agree with Dr. Ortmann that in most cases the supposed 'bipolarity' does not exist, and I may refer him to some remarks of my own published last June, which show very much the same for the Tunicata as he does for the Crustacea. The statements in question appear in a paper on Simple Ascidians from Puget Sound (Trans. Biol. Soc., Liverpool, Vol. XII., p. 248), in which, while pointing out the close similarity between the Tunicata faunas of the west coast of Europe and North America and their possible relation to a northern circumpolar fauna, I criticised Murray's 'bipolar' lists and gave as my opinion that "the distribution of Tunicata as a whole does not lend any support to the bipolar hypothesis." I further stated that "this matter must be settled by specialists in each group of animals stating their opinions as to the genetic affinities of the northern and southern faunas in their own groups, quite apart from and uninfluenced by general lists containing other groups." I am glad to see that this is what Dr. Ortmann and others are now doing.

I would add: There is one thing more we need, and here I am sure Sir John Murray and other naturalists will concur, and that is, more facts, further investigations. There is every prospect now, with the various Antarctic expeditions in the field or proposed, that we shall shortly be in possession of more information from the far South. It is to be hoped that American and British naturalists will see to it that our own polar seas are more thoroughly explored in the near future, both by dredge and tow-net. In advocating Antarctic expeditions we must not forget how much still remains to be done within the Arctic Circle.

W. A. HERDMAN.

UNIVERSITY COLLEGE, LIVERPOOL,
October 22, 1898.

PERIDINIUM AND THE 'RED WATER' IN NARRAGANSETT BAY.

DURING the last two months the inhabitants of Rhode Island witnessed the following remark-

able phenomenon. The water of a considerable portion of the Bay became thick and red, emitting an odor almost intolerable to those living near by. The situation became alarming when, on the 9th and 10th of September, thousands of dead fish, crabs and shrimps were found strewn along the shores or even piled up in windrows.

At the request of the Rhode Island Commission of Island Fisheries, an investigation was made to determine the cause and extent of the unusual color of the water and of the great mortality of the fish. The results of this investigation are briefly as follows:

During the last of August, throughout September and a part of October streaks of red or 'chocolate' water were observed from near Quonset Point and Prudence Island, north to Providence, and, on he flood tide, up the Seekonk River, nearly to Pawtucket, a range of about fifteen miles. In other parts of the Bay, as far as could be learned, the phenomenon had not been observed.

On the 8th and 9th of September the water became extremely red and thick in various localities from East Greenwich to Providence, and the peculiar behavior of the marine animals attracted much attention. Myriads of shrimps and blue crabs, and vast numbers of eels, menhaden, tautog and flatfish came up to the surface and to the edge of the shore as though struggling to get out of the noxious water. Indeed, the shrimp and crabs were observed actually to climb out of the water upon stakes and buoys and even upon the iron cylinders which support one of the bridges and which must have been very hot in the bright sun. In several instances, on these two days, hundreds of blue-crabs were caught by a single individual in a few minutes' time, at the mouth of the Seekonk.

On the following day, September 10th, and for several days afterwards, hardly a live crab or shrimp could be found. Along the shores, however, in the same vicinity, cartloads of dead shrimp were piled up in windrows, and among them were strewn great numbers of crabs and fish of various kinds, especially menhaden and eels. This singular behavior and alarming mortality of marine animals was reported from nearly every station at which the red water occurred, and from no other station, which indicates that the two phenomena are related as cause and effect.

It was commonly believed that dye-stuffs or other refuse emptied into the rivers at the upper part of the Bay gave to the water its color and unpleasant odor, but microscopic examination showed that the water was swarming with minute organisms, a species of *Peridinium*. The *Peridinium* is reddish brown in color and occurred in such excessive abundance that it gave to the water its peculiar color and odor, besides making it so opaque that one could hardly see a white shell six inches below the surface.

With regard to the systematic position of this organism there is a difference of opinion. It is, in fact, ranked with the animals by some authors and with the plants by others. I have not yet been able to determine the species of our *Peridinium*. It resembles in many respects Carter's *Peridinium sanguineum;* it is much flattened, and the anterior end is distinctly bilobed, like *Peridinium tabulatum*, though the lobes are more rounded. Besides a flagellum extending forward from the ventral groove, a very large flagellum lies in the equatorial sulcus and entirely encircles the body. No cilia could be demonstrated.

After September 9th and 10th, when the great mortality of fish occurred, the *Peridinium* became, for a few days, less abundant, and then increased again until the 23d. There was a heavy rain on the 23d, and on the following day the water was comparatively clear. Since this date it has been more or less in evidence up to the day of writing (October 7th). On September 21st the number of *Peridinium* per cubic centimeter in the Seekonk River was estimated at 5,880. This was enough to give the water a very noticeable red color. Nevertheless, the marine animals appear not to have been seriously affected since September 10th or 11th, though the approach of a streak of red water has, in some instances, interrupted good fishing.

In the Seekonk River the shrimp and crabs gradually returned, and in about three weeks after the sudden mortality were nearly as numerous as before, though the water was at times distinctly colored. On the 23d some shrimp, oysters and small fish (*Fundulus*) were

kept in the water where the *Peridinium* were the thickest, and suffered no apparent injury. In consideration of these facts, it has been doubted whether the *Peridinium* was the immediate cause of the peculiar behavior and death of the fish which occurred on the 9th and 10th of September, especially as the weather had been phenomenally hot for several weeks previous to that date. I believe, however, that the *Peridinium* was the cause of the trouble, and not the hot weather nor manufacturers' waste, for the following reasons:

On the two or three days in which the mortality took place the water was extremely red.

The hot weather was followed by a cold wave a day or two before the mortality commenced.

The phenomena occurred in Greenwich Bay and off Nayatt, many miles from any considerable source of contamination.

Finally, the phenomena in question were noticed by very many persons throughout the whole range of the red water, while in neighboring portions of the Bay, for example, in the Warren River and in Bristol Harbor, where the temperature of the water is quite as high as in the red-water districts, no *Peridinium* and no mortality or unusual behavior of the marine animals was reported, though the regions were carefully canvassed.

There are many recorded instances of salt and of fresh water colored red probably by *Peridinium* of this or a similar species. H. J. Carter, in his account of 'The Red Coloring Matter of the Sea round the Shores of the Island of Bombay,' described the new species *P. sanguineum*, which produces this effect. He points out, also, that Darwin's description of the animalcule which he found to color the sea red, a degree south of Valparaiso, accords exactly with that of *Peridinium*. The animalcules which, according to Salt, produce the red color in the Red Sea, may also be due to this form, and the same cause may perhaps be ascribed to the red color of the sea off Iceland in 1649. Porter quotes "the following passage from an eye witness of a similar occurrence at Porebunder, on the coast of Khattywar, India, where the red water is extremely common, viz.: 'the color of the sea water on Saturday evening last, the 27th of October, 1849, was changed from its usual tint to a deep red, emitting a most foul smell; the fish speedily were all destroyed and washed upon the beach in large quantities, etc.'" Though the narrator believed that this might be due to a submarine eruption of mud, Mr. Carter is inclined to ascribe it to some 'animalcule,' most probably *Peridinium*. He also directs attention to the Mosaic account of the plague of Egypt given in the following verses: "And all the waters that *were* in the river were turned to blood." "And the fish that *was* in the river died; and the river stank, and the Egyptians could not drink of the water of the river; and there was blood throughout all the land of Egypt."

A. D. MEAD.

ZOOLOGICAL BIBLIOGRAPHY.

TO THE EDITOR OF SCIENCE: The report on Zoological Bibliography, summarized in your issue of November 4th, is evidently conceived primarily from the point of view of the bibliographer, but from that of the working zoologist it is open to criticism in several details. Chief among these is rule 3, in which the standpoint is made especially conspicuous from the unwarranted assumption that the publication of the separate papers of a volume before the volume as a whole is issued is 'improper,' while the indefinite delay of their publication is 'proper.' It seems to the writer that the propriety or impropriety really consists in the indefiniteness of date, which may or may not accompany the separate publication. This may be, and should be, avoided in a much more simple and easy manner than the remedy proposed by the committee. It is only necessary that the separates as issued should each bear its own date and that the table of contents issued with the volume should state under each title 'author's copies issued' at such and such a date. For the progress of science, as well as the convenience of workers, it is much more important that separate papers should be promptly issued and distributed to specialists than that the volume should be issued at all. The above method has been employed by the Philadelphia Academy of Natural Sciences, and the method of separate publication of all papers has been adopted by most of the Washington

societies, as well as the National Museum, to the very great convenience of everybody concerned. I have never found any difference of opinion among working zoologists on this point.

Wm. H. Dall.

Smithsonian Institution, November 5, 1898.

THE NERNST LIGHT.

To the Editor of Science: Several months have passed since the report of the discovery of a new incandescent electric light by Professor Nernst, of Göttingen. It was rumored that a Berlin firm had bought the patent for five million Marks, and that we were on the eve of another revolution in the illuminating industry, but till recently very little reliable information has been obtained. In the meantime Professor Nernst has been developing and perfecting his invention, and his researches have been crowned with such success that we may look forward to the early appearance of the finished lamp, and perhaps the confirmation of the most sensational rumors.

The astonishing progress in illumination during recent years has been characterized by a great race between gas and electricity. Scarcely had the incandescent light secured a firm hold in the practical world when Auer von Welsbach made his famous improvement on the gas light, and the possibility of the use of acetylene became apparent, so that many believed electricity would after all have to yield the supremacy to gas. Nernst now reclaims the palm for electricity, for he expects that the cost of his light for a whole evening will be no more than that of the Edison for an hour.

The Nernst light requires neither vacuum nor tender filaments. The essential point of the invention is that when substances like magnesia (magnesium oxide) and clay are heated above 3,000 degrees Celsius (6,000° Fahr.—far above the melting point of platinum) a very weak current is sufficient to keep them in an intensely luminous condition. Either direct or alternating currents may be employed, and the magnesia is little injured by use. The only difficulty that remains to be surmounted is a practical and inexpensive appliance for heating the substance to the necessary temperature. The work is, however, progressing and those who know the ability and courage of the inventor are confident that he will succeed.

Professor Walter Nernst, though unknown to most people, is a scholar of high rank in the purely scientific world, and his works or their translations are to be found in almost every scientific library. His brilliant researches won him the newly established chair of physical (theoretical) chemistry at Göttingen, and he is surrounded by advanced students of the most varied nationalities, all of whom greatly admire his fertile mind and genial, inspiring manner. His new invention is but another example of the benefit that patient, conscientious scientific study is sure to bring to the whole world.

H. C. Cooper.

Heidelberg.

THE DAY OF THE WEEK.

To the Editor of Science: The statement made in your issue of Science for October 18, 1898, by Mr. Edward L. Stabler, that 'I have not found any published rule for the simple problem of determining mentally the day of the week without reference to a calendar or lengthy table' leads me to send you the following formula, which I have never seen in print, but which is of so simple derivation that it may well have been used by others than myself.

Let Y represent any year of the Gregorian calendar and D the number of any day in that year, *e. g.*, for February 1, 1898, $Y = 1898$ and $D = 32$. Neglecting fractions, put

$$Y + D + \frac{Y-1}{4} - \frac{Y-1}{100} + \frac{Y-1}{400} = 7n + r$$

where n is the quotient and r the remainder obtained by dividing the first member of the equation by 7. The remainder r then represents the number of the day of the week, *e. g.*, if $r = 1$ the given date falls on Sunday, etc., and if the division is exact, $r = 0$, it falls on Saturday. For the date given above we have

Y		1898
D	+	32
$(Y-1)/4$	+	474
$(Y-1)/100$	−	18
$(Y-1)/400$	+	4
		7)2390
n		341
r		3 = Tuesday.

Dates given in the Julian calendar must first be transformed to the Gregorian calendar before applying the above formula, and this transformation is readily effected through the relation

$$G = J + (N - 2) - \frac{N}{4}$$

where G and J are the respective dates, N is the number of the century, and the remainder is to be neglected in the division by 4.

GEO. C. COMSTOCK.

WASHBURN OBSERVATORY,
MADISON, WIS., October 31, 1898.

NORTHERN ROCKY MOUNTAIN GLACIERS.

TO THE EDITOR OF SCIENCE: For some years I have been interested in the geography of a small section of the Rocky Mountains which, until recently, was part of the Blackfeet Reservation, in northwestern Montana. This section lies, for the most part, east of the Continental Divide and between the international boundary on the north and the Great Northern Railroad on the south. The portion of it which I know best is included in the watershed of the St. Mary's River and its tributaries. In 1891 I took to the head of the St. Mary's River the first party that had ever visited it, so far as known, and in 1895 accompanied to the same point the Government Commission which afterwards purchased from the Blackfeet Indians the rough mountain land which formed the western portion of the reservation of that tribe. Before that I had made a sketch map of the region, which is the basis of all the maps of it that have been made or published.

In 1897 I made a hasty trip to the head of the river and climbed Mt. Jackson, the highest peak in that region. Last July (1898) I again went to the head of the river and climbed the Blackfoot Mountain, another lofty peak somewhat less accessible than Mt. Jackson. On both trips I was accompanied by my friend, Mr. J. B. Monroe.

These last trips have enabled me definitely to locate two points about whose relations I have never until now been quite certain. One is the Pumpelly glacier, discovered by Professor Raphael Pumpelly, who, I believe in 1883, with a small party which included the late W. A. Stiles, crossed from the Flathead country to the Plains by way of the Marias, or, as it is now called, the Cut Bank Pass. This great mass of ice, which is seen by every traveler going through the Cut Bank Pass, rises to the height of several hundred feet above the face of a lofty cliff, over which portions of the glacier are constantly falling with tremendous reports, which are heard for a long distance.

From the top of the Blackfoot Mountain the whole country leading up to the Cut Bank Pass can be seen, and immediately below it to the southeast lies the Pumpelly glacier, readily identified not only from its position with relation to the valley, but also by the peaks and rocks in its neighborhood. It thus appears that the Pumpelly glacier, as I have long supposed was the case, is part of the southern flow of the great ice cap which covers almost the whole of the Blackfoot Mountain. The Blackfoot glacier, which stretches away in a northeasterly direction from the peak of the Blackfoot Mountain, though perhaps varying in extent somewhat with the season, was estimated last July to be six or seven miles long, and in some places between three and four miles wide. From the peak of the Blackfoot Mountain the ice field flows also in a northerly direction, meeting another which runs down between Mt. Kainah and Mt. Jackson, while from Mt. Jackson a number of smaller glaciers flow down to timber line.

A little to the west of south of the Blackfoot Mountain and lying in a great bend of Mud Creek — tributary of the Flathead — which entirely cuts it off from the main range, lies Mt. James, one of the three highest peaks in this immediate section. Seen from the east, it is shaped like the square-faced, peaked end of a hay stack, and at a distance appears very difficult or impossible of ascent. Its southern and western faces may be more practicable than those on the north and east appear. From the top of the Blackfoot Mountain the level shows Mt. Jackson to be the highest of all these mountains; Mt. James the next, while Blackfoot is the third. But the differences in height are very slight.

A few miles northwest of Mt. Jackson, and

lying on the west side of the range, lies a little basin named Avalanche Basin by Mr. L. B. Sperry, of Oberlin, Ohio, and on the mountains overlooking this, Mr. Sperry tells us, are extensive snow fields and a glacier. From the summit of Blackfoot Mountain it appears that this Avalanche Basin lies nearly south of Mt. Piegan of my map, and southwest of Mt. Reynolds. I understand that Mr. Sperry, who was, of course, unaware that the mountain had been earlier named, has called Mt. Reynolds Matterhorn from the slender—as seen from the southwest—finger of rock which forms its peak. Mt. Reynolds is in the Continental Divide, although most of the recent maps wrongly place it east of the Divide.

If the locations of the Pumpelly glacier and of Avalanche Basin with regard to definite and well-known points in the Continental Divide are thus established, the matter is one of some interest to students of this section of the northern Rocky Mountains, since hitherto, so far as I am aware, the relations of the east and west sides of the range have not been known between the head of Belly River and the Cut Bank Pass.

Lying nearly to the south of Mt. Jackson, and between it and the Blackfoot Mountain, is a deep basin which is the head of Harrison Creek, flowing down toward the Flathead Lake. This basin, which I have called Pinchot's Basin, is occupied by a large glacier, which is fed by many smaller ones flowing down the steep side of Mts. Jackson, Kainah and Blackfoot. What the extent of this glacier may be I do not know, but lying in this deep basin, and almost completely surrounded by high mountains, the area of the moving ice must be very considerable.

Geo. Bird Grinnell.

SCIENTIFIC LITERATURE.

Outlines of the Earth's History. By N. S. Shaler. D. Appleton & Co. 1898. Price, $1.75.

This 'Popular Study in Physiography' is the latest of a number of attractive publications dealing with geological and geographical themes, from the pen of the professor of geology at Harvard. As in the case of the 'Aspects of the Earth,' published in 1889, the present volume of over four hundred pages is a series of essays on some of the broader phases of the earth's history.

Popular scientific books, well written, clearly printed and attractively illustrated, are year by year becoming more and more numerous, and are taking the place of novels, especially among the more intellectual and cultivated readers. It is to this as yet small library of nature-novels that the 'Outlines of the Earth's History' belongs.

The nine essays comprising the volume and forming as many chapters are:

I. An introduction to the study of nature.
II. Ways and means of studying nature.
III. The stellar realm.
IV. The earth.
V. The atmosphere.
VI. Glaciers.
VII. The work of underground water.
VIII. The soil.
IX. The rocks and their order.

As may be seen from this outline, the volume, although embracing a wide view of nature, is not a systematic treatise, and does not fill the place of a text-book on physiography. It is a collection of graphic essays, each of which may be read separately without detracting from its value, designed to lead the reader by easy paths to a sufficiently elevated, intellectual standpoint, to command a comprehensive view of what the author terms the natural realm.

Following the first two chapters, which are of the nature of an introduction, dealing briefly with the ways in which barbarous and civilized men view their surroundings, and suggesting methods to be pursued in nature study, comes a description of the stellar realm. Most of the material in this third chapter is of necessity borrowed from astronomy, and presents, among other discussions, a clear statement of the nebular hypothesis, as formulated by Kant and Laplace. But scant, if any, attention is given, however, to the modification of this explanation of the earth's origin, presented especially by Lockyer and known as the meteoric hypothesis. A reason for this omission is perhaps to be had later in the book, where it is stated that meteors may possibly have been ejected by volcanoes of our own and other planets, a view

that is not shared by many students of nature. As meteors are still coming to the earth, and everyone has seen 'shooting stars,' the meteoric hypothesis, by appealing to a process still in action, by which the earth may have been formed, is particularly attractive as a subject for popular presentation.

The chapter on the atmosphere contains not only an instructive summary of some of the leading facts concerning the outer envelope of the earth, but, overstepping all stereotyped methods, deals also with the changes which the movements of the air, and the circulation of water vapor in it, make upon the seas and lands beneath. The freedom in this connection that a popular essay seems to demand, is indicated by the variety of themes embraced in this discussion of the atmosphere. These are 'whirling storms;' 'the system of the waters,' including the waters stored in the earth or rock-waters, the nature and origin of tides, the action of shore waves, the character of sea beaches and cliffs, etc. 'ocean currents,' their influence on climate and on the distribution of life, and connection with past geological changes; 'the circuit of the rain;' 'the geological work of water;' under which falls the sculpturing of the land by streams; and 'lakes.' Such a highly complex group of subjects in a chapter of one hundred pages, while not to be tolerated in a systematic treatise on physiography, does not seem out of place in a story book of nature. Systematic works are apt perhaps to impress one with the view that the operation of natural forces are independent and stand alone, each complete in itself, but a more general view, in which their mutual dependence and interaction are made prominent, is no doubt best for popular presentation. However comprehensive a book may be, one essential is that facts and principles should be accurately stated. Here enters one of the leading difficulties in popular writing. For example, on page 101, in describing the ascent of warm air in circular storms, the draft in a chimney is introduced as an illustration, and the statement made that 'the heated lower air breaks its way up the shaft, gradually pushing the coolor matter out at the top,' and, later, 'wherever the air next the surface is so far heated that it may overcome the inertia of the cooler air above, it forces its way up through it in the manner indicated in the chimney flue.' Now, does the warm air rise and force its way through the cooler and denser air above, by reason of any force inherent in itself; is it not that the attraction of the earth is less, volume for volume, for warm than for cold air; the former being forced to rise by the denser air following under it and forcing it upward.

In this same connection attention may be directed to certain statements which, as the saying is, would 'puzzle a mathematician.' In discussing the flattening of the earth at the poles, page 82, we read, 'the average *section* at the equator being about twenty-six miles greater than that from pole to pole.' Again, in writing of the rebound of a marble when dropped on the floor, page 366, it is stated that the marble becomes 'shorter in the axis at *right angles to the point* which was struck;' also, on page 369, occurs the statement that the 'movements of this wave are at *right angles to the seat* of the originating disturbance.' The italics are by the present writer, and meant to emphasize the opinion that these statements are unintelligible.

One aim in popularizing science is to root out superstitions and in their place, if possible, substitute rational explanations. In this connection Shaler strikes a blow at the time-honored 'Jack-o'-lantern' or 'Will-o'-the-Wisp' which many of us have been looking for in vain since childhood. This ancient spook needs to have better credentials, or else forever disappear from our swamps; or, more accurately, its uncertain light should be dispelled from men's fancies.

The breadth of view and comprehensive character of the remaining essay n glaciers, the work of underground water, the soil, etc., is perhaps sufficiently indicated by the statements just made in reference to the complex groups of phenomena discussed in the chapter devoted to the atmosphere.

Throughout the book there is an aim to cultivate what has been termed the scientific use of the imagination, or the power of forming mental visions of the relations of matter, space, time, etc., which are beyond the power of the eye to grasp, and transcend daily experience.

The earth, for example, as it would appear to an observer on the moon, with the daily passage of its continents from light to shadow, and annually recurring seasonal changes, requires an exercise of the imagination of a high order. In a similar way, various hypotheses to account for the origin of the earth, the larger movements of the atmosphere and of the ocean, the flow of glaciers, the origin of volcanoes, etc., call not only for a knowledge of facts and principles, but the power to group them in the imagination and follow step by step the many changes that are involved. The student of nature has to create in his own mind pictures of the workings of nature ranging in scale from the movements of molecules to the revolution of planets and siderial systems. It is in this field that the book before us excels. One cannot read its glowing pages without having his imagination greatly stimulated. The rigid boundaries that circumscribe systematic treaties are very properly ignored, and freedom given the imagination to build castles, or rather cathedrals, in the air, to illustrate Nature's architecture.

One phase of the use of imagination in scientific research is the trial by hypotheses. As many plausible explanations as possible of a given phenomena are invented, and the erroneous ones eliminated by careful tests. In this process of multiplying of hypotheses but few men excel the author of the book under review. The search for a true explanation necessitates the destruction of many trial explanations. Every scientific investigator, it has been said, lives in the midst of a cemetery of defunct hypotheses. Strange as it may seem to the uninitiated, every true investigator tries to kill his own hypotheses, in order that only the strong may live. His zeal in this direction being excelled only by the desire to kill the hypotheses proposed by others. In the intangible world of ideas, as in the organic realm, the fittest survive. To most readers of popular science this struggle is practically unknown, and the hypotheses presented to them are accepted as well established laws. For this, if for no other reason, only such hypotheses as have been exposed in the searchlight of criticism, and have been generally accepted by specialists in the particular field of science to which they pertain, deserve a place in popular-science books. It is in this connection that the volume before us seems most widely open to criticism.

An explanation of the movements of the tides and the flow of glaciers placed side by side before the general reader or the student just entering on the study of nature, are accepted as equally worthy of credence, and are apt to take such firm root in the mind that a shock is felt when one of them has to be modified or rejected.

The explanation of the flow of glaciers, and especially the view that continental glaciers, in their central and deeper portions, float on a cushion of water or of half-melted ice, for the reason, if no counteracting agency exerted an influence, that the ice at the bottom of such a glacier would melt because of the presence of its own mass, the melting point of ice being lowered by pressure, is one of the many attractive hypotheses that have sprung from Professor Shaler's fruitful brain, but one not generally accepted by glacialists. This tendency to give precedence to one's own hypotheses is again manifest in discussing the nature and origin of volcanoes. The changes which water-charged sediments would undergo if depressed to a depth of many thousands of feet (Shaler suggests twenty miles!) is elaborated as the main explanation of the origin of volcanoes. While this hypothesis fascinates the mind, and explains many of the facts observed during volcanic eruptions, notably the vast volumes of steam given forth, it has not withstood the tests of criticism in such a way as to warrant its presentation to the public as the sole and final explanation of volcanic phenomena.

While it is not the province of a reviewer to dwell on typographical errors, I will note one slip for which having been called to account myself, I can warn others against. In the English translation of Palmieri's book on the Eruption of Vesuvius in 1872, a certain gulch on the side of the mountain is called the 'Atria del Cavallo,' the word *atria*, according to the dictionaries, should be *atrio*. This mistake has been repeated on page 285 of the book under review.

While several of the plates reproduced by Shaler are excellent, notably the one of a pebble-beach and the pictures of breakers on the shore of Martha's Vineyard, some of the cuts in the text are decidedly poor. The small woodcut intended, according to title, to represent a sun spot, and another of a portion of the moon's surface, should certainly be replaced by something better in future editions.

In the preface of the volume the statement is made that it is intended for beginners in the study of the earth's history. It seems to the present writer that this claim is too modest, as the book can be used with both pleasure and profit by the advanced student and even by the most experienced veteran in physiography, as well as by the novice. In fact, the many suggestions and original observations, strewn thickly along the general pathways that are followed, are among the greatest charms of the book. Some of these branches of the general current of thought may perhaps lead the beginner astray, but to more experienced explorers they serve to show how vast is the space surrounding the known.

In every library there should be a new shelf for romances of nature, and one of the first books to be placed thereon, whether in the home, school, university or circulating library, should be the 'Outlines of the Earth's History.'

ISRAEL C. RUSSELL.

Die Chemie in täglichen Leben. Gemeinverständliche Vorträge. By PROFESSOR DR. LASSAR-COHN. Hamburg und Leipzig, Leopold Voss. 1898. Third Edition. 8vo. Pp. vii+317.

A German book on chemistry which has experienced three editions in as many years, and translations of which into several foreign tongues have been made or are in preparation, as the author's prefaces inform us, must have struck a responsive chord in public favor.

These lectures on chemistry in daily life are twelve in number. They cover a wide range of topics; foods, illuminants, explosives, leather, coal-tar colors, ceramics, Röntgen rays and many other subjects are discussed.

At times the grouping of themes presented in one lecture seems rather incongruous. Thus, in one instance, lecture twelve, metallic alloys, alkaloids, anæsthetics, anti-pyretics and disinfectants all come in for consideration.

This appears to be rather a varied menu for an intellectual repast, especially if one intends following the author's admonition and dispose of it at one sitting. For the preface says: "As the individual lectures had the customary duration of one hour a corresponding amount of time ought to be devoted to their perusal."

The style is terse and clear; typography and paper good.

FERDINAND G. WIECHMANN.

Introduction to the Study of Organic Chemistry. By JOHN WADE, B.SC., Senior Demonstrator of Chemistry and Physics at Guy's Hospital. London, Swan, Sonnenschein & Co. 1898.

The author has adopted a method of treating the subject which is exactly the reverse of that commonly employed. He starts not with the simple hydrocarbons, but with some of their derivatives, and does not give the properties, etc., of the hydrocarbon until he has taken up the complex derivatives. As he states in the preface, 'the book proceeds from the familiar to the unfamiliar.' The application of this method can, perhaps, be best shown by an extract from this preface: "The first substances to be studied are the typical alcohol and acid akin to the inorganic bases and acids, and the study of these leads to the theory of radicals. The other simple alcohols and acids are next dealt with, and the ideas of homology and isomerism introduced. The construction of the net-work of cross connections typical of organic chemistry is now commenced, with the aid of the ammonia derivatives and cyanogen compounds, and the necessity of the theory of structure shown. The structural formulæ of the various compounds having been duly established, the simple aldehydes are introduced, and with them the conception of polymerism; then the simple ketones and secondary alcohols, with the theory of position isomerism; and the iso-alcohols and acids, with the theory of branching-chain isomerism. Finally, the simple hydrocarbons are dealt with, and the preceding work codified in the theory of substitution."

It is difficult to see how one can gain a clear idea of the more complex substances without

an understanding of the simpler member from which it is derived. A knowledge of the present conception of the structure of benzene is certainly necessary in order to understand the isomeric compounds and the formation and reactions of the complex derivatives. The subjects are quite fully developed, with charts to illustrate the relationship of substances to one another, and methods of preparation, for use in a laboratory, are given in an appendix, as is also a short review of the general method of testing for the commoner organic substances. The book is intended evidently for men preparing for Board examinations.

J. E. G.

SCIENTIFIC JOURNALS.

The Journal of Physical Chemistry, June: Molecular Weights of Liquids, two papers by Clarence L. Speyers. Benzilorthocarboxylic Acid, by C. A. Soch; a study of the two modifications. Analysis of Aqueous Alcohol, by Chester B. Curtis; the method proposed is titration with toluene until milky turbidity appears. The results are as accurate as the pycnometer tests, are simple and rapid. The delicacy of the test increases rapidly with the strength of the alcohol. The Benzoyl Ester of Acethydroxamic Acid, by Frank K. Cameron; a study of the two modifications. Boiling-point Curve for Benzene and Alcohol, by E. F. Thayer. October: Benzaldoxime, by Frank K. Cameron. The Isothermal Pressure-surface in the Case of Two Single Salts and one Double Salt, by F. G. Donnan. The Molecular Weight of Orthorhombic, Monoclinic and Plastic Sulphur in Naphthalene and Phosphorus by the Freezing-point Method, by Samuel D. Gloss; from the boiling-point method in carbon disulfid and in benzene, Orndorff and Terasse conclude that orthorhombic and monoclinic sulfur have the same molecular weight; Blitz by the vapor-density method reaches the same result for orthorhombic and plastic sulfur; the author also concludes from a series of determinations by the freezing-point method, using naphthalene and phosphorus as solvents, that the molecular weights of the three varieties of sulfur are the same. The Variance of the Voltaic Cell, by Wilder D. Bancroft; the object of this paper is to show the way in which the phase rule should be applied to reversible cells, and to call attention to the usefulness of the theorem of La Chatelier in predicting the change of the electro-motive force with the change of the parameters.

The October number of the *Bulletin of the American Mathematical Society* contains an account of the Fifth Summer Meeting of the Society, by the Secretary: 'Note on the Generalization of Poincaré and Goursat's Proof of a Theorem of Weierstrass',' by Professor W. F. Osgood; 'Supplementary Note on a Single Valued Function with a Natural Boundary, whose Inverse is also Single Valued,' by Professor W. F. Osgood; 'Note on the Periodic Developments of the Equation of the Center and of the Logarithm of the Radius Vector,' by Professor A. S. Chessin; 'The Theorems of Oscillation of Sturm and Klein (Third Paper),' by Professor Maxime Bôcher; 'Notes;' and 'New Publications.' The November number of the *Bulletin* contains a report on the Cambridge Colloquium, by Professor H. S. White; the six lectures on 'Selected Topics in the General Theory of Functions,' delivered before the Colloquium by Professor W. F. Osgood; a report of the Boston meeting of Section A of the American Association for the Advancement of Science, by Professor ames McMahon; 'Notes;' and 'New Publications.' Each of the two numbers fills 56 pages.

The *American Journal of Science* for November contains the following: 'Irregular Reflection,' by C. C. Hutchins; 'Occurrence of Sperrylite in North Carolina,' by W. E. Hidden; 'Description of a Fauna found in the Devonian Black Shale of Eastern Kentucky,' by G. H. Girty; 'Separation of Nickel and Cobalt by Hydrochloric Acid,' by F. S. Havens; 'Contributions to Paleontology,' by F. A. Lucas; 'Value of Type Specimens and Importance of their Preservation,' by O. C. Marsh; 'Origin of Mammals,' by O. C. Marsh; 'Causes of Variation in the Composition of Igneous Rocks,' by T. L. Walker; 'Relation between Structural and Magneto-optic Rotation,' by A. W. Wright and D. A. Kreider.

THE frontispiece of *Appleton's Popular Science Monthly* for November is a portrait of Professor F. W. Clarke, Chief Chemist to the United States Geological Survey, and the number contains an account of Professor Clarke's contributions to the advancement of science. In the first article in the number Professor E. S. Morse asks whether middle America was peopled from Asia and answers in the negative. Mr. C. R. Dodge contributes an elaborately illustrated article on the possible fiber industries in the United States, and there are, as usual, a number of interesting articles relating to different departments of natural and social science.

Natural Science announces that it will be transferred to a new editor, who will continue the journal on the same plan as heretofore. Further particulars are deferred until December.

THE jury on 'Imprimerie et Industries de Livre' of the Brussels International Exposition has awarded the *Scientific American* a diploma of merit and a silver medal.

SOCIETIES AND ACADEMIES.

AMERICAN MATHEMATICAL SOCIETY.

A REGULAR meeting of the American Mathematical Society was held at Columbia University, New York City, on Saturday, October 29th. Thirty-six persons were in attendance, including twenty-nine members of the Society. The meeting extended through two sessions, beginning at 10:30 a. m. and 2:30 p. m. The President, Professor Simon Newcomb, occupied the Chair. The Council announced the election of the following persons to membership in the Society: Mr. E. B. Escott, Grand Rapids, Mich.; Dr. L. B. Mullen, Cleveland, O.; Professor J. M. Peirce, Cambridge, Mass.; Professor Alexander Pell, Vermilion, S. D.; Professor Arthur Ranum, Seattle, Wash.; Mr. A. N. Whitehead, Cambridge, Eng.; Mr. W. C. Wright, Boston, Mass. Five applications for membership were received. The total number of members of the Society is now 315. At the meeting of the Council nominations of officers for the coming year were made, and a report was received from the committee appointed at the preceding meeting to consider the question of improved facilities for the publication of the result of original research in mathematics in this country.

The following papers were read at the meeting:

1. Professor F. MORLEY: 'A regular configuration of ten line-pairs in hyperbolic space.'

2. Professor R. S. WOODWARD: 'The mutual gravitational attraction of two bodies whose mass distributions are symmetrical with respect to the same axis.'

3. Professor E. D. ROE: 'On symmetric functions.'

4. Professor A. S. CHESSIN: 'Note on the problem of three bodies.'

5. Professor MAXIME BÔCHER: 'On singular points of linear differential equations with real coefficients.'

6. Professor E. O. LOVETT: 'Contact transformations of developable surfaces.'

7. Dr. L. E. DICKSON: 'The largest linear homogeneous group with an invariant Pfaffian.'

F. N. COLE.

BIOLOGICAL SOCIETY OF WASHINGTON.—296TH MEETING, SATURDAY, NOVEMBER 5.

MR. F. V. COVILLE exhibited a specimen of lava from Mt. St. Helens, bearing the impression of the bark of a pine, saying that he had been told of the existence of stumps and logs buried in the lava on that mountain.

Mr. Albert F. Woods showed some leaves 'skeletonized' by the small fresh-water crustacean *Cypridopsis*.

Mr. H. J. Webber noted the occurrence of several sports of a species of *Clarkia* which had borne ripe seeds, a thing rather unusual among sports.

Mr. D. G. Fairchild spoke of 'the Dutch Botanical Gardens at Buitenzorg, Java,' illustrating his remarks by photographs. He said that the gardens practically were a biological station, and that in the future they would undoubtedly be much resorted to by students of all nations. In addition to the gardens at Buitenzorg, which comprised 127 acres, about 800 feet above sea level, there was another 'mountain garden' at Tjibodas, some five hours distant, containing a large tract of forest, ranging from 4,500 to 8,000 feet above sea level.

Dr. L. O. Howard described 'the Outbreak of the Fluted Scale in Portugal, and its Results,' stating that the scale had been brought from Australia to the Cape de Verde Islands on *Acacias*, introduced to form windbreaks for the orange plantations, and thence carried to Portugal. In 1896, when the insect had spread over a considerable extent of territory, the Australian Lady-bug was brought from the United States, with the result that within a year it had practically exterminated the scale insect.

Mr. Charles T. Simpson told of 'the Destruction of the Pearly Fresh-water Mussels' in the central United States, saying that their wholesale gathering for pearls and for use in making buttons threatened to exterminate them in many sections, and the injury was aggravated by the drainage of large tracts and by the contamination of the streams by sewage. The speaker briefly described the breeding habits of the two great groups of fresh-water mussels and suggested some remedial measures.

Mr. F. A. Lucas noted 'the Occurrence of Mammoth Remains on the Pribilof Islands,' stating that Mr. R. E. Snodgrass and the party from Stanford University had, in 1897, obtained two teeth of the Mammoth and bones of a bear, apparently distinct from the existing Polar Bear, from a lava cave on Bogoslof Hill. He was of the opinion that possibly the presence of these bones in such a situation might indicate the comparatively recent connection of the island with the mainland.

F. A. Lucas,
Secretary.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

November 3, 1898. Under the head of exhibition of specimens Mr. Heidemann showed *Dichocysta pictipes* Champion, originally described from Panama, which has recently been collected in the Santa Rita Mountains of Arizona by Mr. Schwarz. Mr. Schwarz showed specimens of a Pyromorphid moth and a Lampyrid beetle from Arizona which appear identical during flight. He described the peculiar flight habits of both species. Dr. Dyar stated that the mimicry is complicated in this case by the fact that there are three moths, an Arctiid and a Syntomeid in addition to this Pyromorphid, which with the Lampyrid beetle all look almost exactly alike while flying. Professor Uhler spoke of the progress of his work upon the Capsidæ, showing that from recent collections in Mexico and South America he is beginning to find that many of our United States forms have a much more southern origin than has hitherto been supposed.

Mr. Howard read a paper entitled 'An Insect Breeding in Petroleum,' showing that an Ephydrid fly, described by Mr. Coquillett in connection with this paper as *Psilopa petrolei* n. sp., breeds in large numbers in crude petroleum pools in the neighborhood of oil wells near Los Angeles, Cal. This insect has not previously been mentioned in entomological literature. It has been known to oil men for some time and is referred to incidentally by S. F. Peckham in his 'Report on the Production, Technology and Uses of Petroleum and Its Products' in Volume X., Tenth Census Reports.

Mr. Schwarz continued his paper of the previous meeting on 'Southern Arizona and its Insect Fauna,' speaking especially of the sharp demarcations in the life zones in Arizona on account of the extremely variable altitudes, producing a complexity of zones which is more marked than elsewhere in the United States. He described at length the characteristic features, both botanical and entomological, of the regions mentioned, showing among other interesting points that Dr. Merriam's conclusion that the valley of the Colorado River is tropical is hardly substantiated by a study of the insects. The paper was discussed at length by Messrs. Gill, Howard, Ulke, Pollard, Ashmead and Uhler.

L. O. Howard,
Secretary.

TORREY BOTANICAL CLUB, OCTOBER 11, 1898.

The evening was devoted to informal reports of summer observations and experiences. The Secretary spoke of collections in the White Mountains and on the Massachusetts coast and near Lake Erie.

Dr. Britton spoke of the progress made at the Botanic Garden, especially in the advancement of the museum building, and reported the pros-

perous condition of the herbaceous garden, now with over 2,700 species, a mass of bloom during the season. One day in July the visitors to the grounds numbered 4,000. Interesting questions of specific identity are being confirmed by cultivation at the Garden, as in the case of *Potentilla pumila*.

Dr. Britton also announced the forthcoming scientific expedition to Porto Rico, Mr. A. A. Heller going as botanist under the auspices of the New York Botanic Garden, through the liberality of Mr. Cornelius Vanderbilt.

Dr. Underwood reported botanical work in the forests of Thuringia, and examination of fern types at Berlin. He referred to the excellent preservation of the plants of Willdenow at Berlin, and to the strength of the Berlin Herbarium, enriched by the work of Prantl, the collections of Mettenius, Maximilian-Kuhn and the Hawaiian herbarium of Hildebrand. Dr. Underwood described the new botanic garden laid out by Professor Engler, near Berlin, exhibiting modern ideas of geographic distribution.

Dr. Rusby reported a summer spent largely in procuring material for the study of drugs in powdered condition. Drugs now come chiefly to the pharmacist powdered, and adulterants are less easily recognized.

It was reported that Professor Henry Kraemer, formerly of this Club, had devised a key for powdered drugs. Dr. Rusby's search for genuine *Apocynum cannabinum*, with broad, thick leaves, woolly beneath, has proved disappointing; *A. album*, with recurving habit, replacing it in the region about New York City.

Mr. A. A. Heller spoke of his experience in the Olympic Mountains, where the continuous rains interfered with collections. Ferns grew in great profusion and often five feet high, but of few species. The Salmonberry varied from yellow to deep red and was often an inch in diameter on bushes ten feet high. *Oxalis Oregana* made a fine display, as also several species of *Vaccinium*, *V. parvifolium* with red and *V. ovalifolium* with blue berries. An introduced blackberry, *Rubus laciniatus*, is now well established there, blooming from July to Christmas, and known as the Evergreen Blackerry. *Spiræa Menziesii* grew by the streams, with its rose-colored spike a foot and a-half high. *Lilium Columbianum* appeared in the meadows. There were not many representatives of any family, only about 20 composites out of 250 plants collected, of grasses 35. Later, Mr. Heller collected in August and September, in Texas and Arkansas, with marked success.

Professor Lloyd reported a summer spent in study in the laboratory of Professor Goebel, at Munich, and commented upon the botanic garden there, which, although of but few acres, is exceedingly well arranged for educational purposes.

Mr. M. A. Howe reported work on the Hepaticæ, and his discovery, on a hemlock stump in the New York Botanic Garden, of genuine *Cephalozia connivens* for the first time in the United States, the plant distributed by Austin under that name proving distinct.

Mr. Clute reported work on the sand barren flora of eastern Long Island. Among his collections were *Dryopteris simulata*, only once before recorded from New York State; *Kneiffia Alleni*, new to North America; *Pogonia verticillata*, in quantity near Southampton; *Kalmia latifolia*, within twenty-five feet of the sea-level; *Potentilla pumila* and *P. Canadensis* growing together without mixing.

Discussion regarding violets followed. Professor Britton exhibited some fresh flowers of *Viola cucullata*, borne on peduncles normally cleistogene, and with some of the flowers transitional in character. President Brown spoke of similar flowering in *V. sagittata*. Dr. Britton and the Secretary reported their collecting cleistogenes of *V. Atlantica* this season for the first time. Mr. Clute described his study of the cleistogenes in *V. cucullata*, *V. ovata*, *V. rostrata* and *V. Canadensis*. They are developed during the heat of summer. Cool temperature seems needed to secure free flowering in *Viola*, as also seen in the greenhouse cultivation of pansies. Mrs. Britton called attention to the continuous summer blooming of *V. tricolor* in the cooler climate of the Adirondacks and of the Alps. Mrs. Britton also reported the collection, at Lake Placid, of *Viola arenaria* for the first time in New York State.

EDWARD S. BURGESS,
Secretary.

BOTANICAL SEMINAR OF THE UNIVERSITY OF NEBRASKA.

In a convocation at the opening of the semester, meetings were appointed for October (papers by Dr. Bessey, Dr. Pound and Dr. Clements), November (symposium on cytology led by Dr. Ward), December (papers by Dr. Ward, Dr. Clements and Mr. Horne), January (symposium on physiology led by Dr. Bessey).

October 22, 1898, papers were read and discussed as follows: 'Recent studies in the arrangement of the families of Protophytes,' by Dr. Bessey; 'A review of Pax's Pflanzenverbreitung des Carpathiens,' by Dr. Clements; 'A discussion of Kuntze's Revisio generum plantarum, III[II],' by Dr. Pound.

It was agreed that the last paper should be prepared for early publication.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy of Science of St. Louis on the evening of October 17, 1898, Mr. C. H. Thompson spoke of some interesting stylar movements of certain Marantaceæ, connected with their pollination.

Seven persons were proposed for active membership in the Academy.

At the meeting of the Academy on the evening of November 7, 1898, Mr. James A. Seddon, of the Missouri River Commission, presented a paper on 'Resistance to Flow in Hydraulics,' in which the point was made that relatively a small part of this resistance, so far as open streams were concerned, was directly attributable to friction against the bottom and limiting banks, but that the resistance was found acting between accelerations and impacts and showed in forced distortions of the free surface, from which forms the energy passed into internal motion.

Seven persons were elected to active membership in the Academy.

William Trelease,
Recording Secretary.

ALABAMA INDUSTRIAL AND SCIENTIFIC SOCIETY.

The regular fall meeting of this Society was held in Birmingham, November 8, 1898, Professor M. C. Wilson, of Florence, President, presiding. About fifteen members and others were present. The Secretary read the report of a committee appointed for the purpose of considering the matter of recommending legislation to secure full returns of mineral statistics. In this report it was recommended that the Society ask the Legislature to amend the State mining laws so as to require the operators and lessees of mines, quarries, furnaces, coke works, clay beds and industries based on clay to make monthly returns of their production to the State Mine Inspector, and at the end of the year an annual report of the same. This course, it is thought, would be most likely to secure full and accurate returns. The Society then adopted resolutions requesting the Governor to urge upon the Legislature the importance of making appropriation for the purpose of securing representation for the State at the coming Paris Exposition, and also of memorializing Congress to take suitable steps for bringing about a change in the present French tariff laws so far as regards American iron.

There were no formal papers presented at this meeting, but steps were taken to secure articles at future meetings by assigning definite subjects to members. Seven new members were elected, after which the Society adjourned until the annual meeting in January, at which time there will be an election of officers for the ensuing year.

Eugene A. Smith,
Secretary,

NEW BOOKS.

Food and Feeding. Sir Henry Thompson. London and New York, Frederick Warne & Co. 1898. Ninth Edition, enlarged and revised. Pp. 312. $1.75.

Bush Fruits. Fred. W. Card. New York and London, The Macmillan Co. 1898. Pp. xii+537. $1.50.

Nature Study for Grammar Grades. Wilbur S. Jackman. Danville, Ill., Illinois Printing Co. 1898. Pp. 407.

Répertoire bibliographique des principales revues française pour l'année, 1897. Dr. Jordell. Paris, Per Lamm (Librarie Nilsson); New York, Lemcke & Buechner. 1898. Pp. 209.